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MORALITY BEFORE KNOWLEDGE

MIE-BIN: Innovation of noodles from Madeira vine leaves (*Anredera cordifolia* [Ten.] Steenis) as a strategy for functional food diversification in supporting balanced nutrition fulfillment

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ABSTRACT

Background: In Indonesia, the nutritional situation is still concerning with the prevalence of stunting in children under five reaching 30.8%. Indonesia's rich biodiversity, especially local plants such as Madeira vine, (*Anredera cordifolia* [Ten.] Steenis) offers great potential as an innovative solution to overcome nutritional problems. This research focuses on developing Madeira vine-based noodles (MIE-BIN) as a quality local food diversification strategy with the aim of making a real contribution to fulfilling balanced nutrition and supporting national food security through a comprehensive approach that combines aspects of nutrition, food technology, and local plant potential. **Methods:** This research was conducted through a descriptive analytical literature review with a qualitative approach. This study employed a systematic literature search of primary sources (scientific journals, conference proceedings, research reports, and reference books) and secondary sources (official statistics, policy documents, and government publications) from 2014–2024 to analyze the potential of Madeira vine leaves as a noodle ingredient. **Findings:** The findings show that Madeira vine Noodles (MIE-BIN) have superior nutritional, textural, sensory, and functional properties compared to conventional noodles, offering high protein, fiber, antioxidants, and bioactive compounds with significant health benefits, while also presenting strong potential for diversification, food security, and sustainable community nutrition. **Conclusion:** This innovation shows significant potential in supporting metabolic health through bioactive compounds such as flavonoids and saponins that can reduce the risk of chronic diseases. **Novelty/Originality of this article:** Through modern food technology and innovative approaches, MIE-BIN not only offers solutions for local food diversification, but also has the potential to become a strategic instrument in nutritional interventions, utilization of local resources, and improving the quality of life of the community.

KEYWORDS: antioxidant; dietary fiber; nutrition; protein.

1. Introduction

Global nutrition issues continue to be a complex and evolving challenge, encompassing various forms of malnutrition such as undernutrition, obesity, and micronutrient deficiencies (Wells et al., 2021), necessitating innovative and sustainable solutions. According to Soni & Khan (2023), over 690 million people worldwide suffer from undernutrition, while at the same time, obesity and overnutrition are also on the rise. The inability to meet adequate nutritional needs is exacerbated by the high cost of healthy food

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and the low affordability of nutritious diets for billions of people globally (WHO, 2022). Additionally, climate change has a significant impact on food production, with rising temperatures, droughts, and natural disasters reducing agricultural yields and worsening food security in developing countries (Farooq et al., 2022). Geopolitical conflicts, such as the war in Ukraine, have also caused major disruptions to global food supply chains and spikes in staple food prices (Ben Hassen & El Bilali, 2022). Coupled with global economic instability due to the COVID-19 pandemic and high inflation, the food crisis has become increasingly acute, affecting the accessibility and availability of food for vulnerable populations (Kubatko et al., 2023). Addressing these challenges requires a holistic approach involving nutrition education, food regulatory policies, agricultural technology innovation, and international cooperation to create a more sustainable and resilient food system (Agarwala et al., 2022).

Nutritional problems in Indonesia present a complex picture, with a persistently high stunting prevalence among children under five at 30.8%, alongside underweight and wasting rates of 10.2% and 3.2%, respectively (Rahman et al., 2023). This reflects significant disparities in access to nutritious food, particularly in rural and underdeveloped regions. Research indicates that socioeconomic factors such as per capita expenditure and life expectancy significantly influence stunting rates, while poverty rates and literacy levels have yet to show a meaningful impact (Wirayuda & Chan, 2021).

Moreover, there are striking geographical disparities in malnutrition prevalence across Indonesia. Regions such as Papua, Maluku, and Nusa Tenggara have much higher rates of underweight, wasting, and stunting compared to Java and Bali. In rural areas, stunting prevalence can be 1.51 times higher than in urban areas (Widyaningsih et al., 2022). Contributing factors include infectious diseases, child-rearing practices, and living conditions, all of which worsen the nutritional status of children in various regions (Putri et al., 2025).

These nutritional challenges stem not only from inadequate nutrient intake but also from the interplay of other factors such as low birth weight, child age, maternal education level, and access to healthcare (Sajid et al., 2025). Therefore, a holistic approach is needed to address this crisis. Strategic interventions - such as improving access to nutritious food in disadvantaged areas, public nutrition education, and strengthening socioeconomic policies - can be crucial steps in reducing malnutrition rates among Indonesian children.

Indonesia's rich biodiversity holds great potential in addressing nutritional challenges, particularly through the utilization of underoptimized local plants. One promising indigenous plant is Madeira vine (*Anredera cordifolia* [Ten.] Steenis), known for its high nutrient content and diverse bioactive compounds with significant health benefits. Research by Rohaeni et al. (2024a) shows that Madeira vine leaves contain flavonoids, saponins, and antioxidants that may enhance immunity, reduce inflammation, and combat free radicals.

Despite its potential, Madeira vine remains underutilized in Indonesia's food and public health contexts (Rohaeni et al., 2024b). This may be due to limited public awareness of its benefits and insufficient research on processing and preparation methods for consumption. With the right approach, Madeira vine could serve as an alternative nutritious food source, helping to meet dietary needs while supporting local agricultural sustainability (Rahayu et al., 2024).

Public education on incorporating Madeira vine into daily diets–whether as fresh vegetables or processed products–is essential. Further research is also needed to explore its applications in the food and health industries, including the development of Madeira vine-based products to improve accessibility and nutritional awareness (Tedjakusuma & Lo, 2022). Thus, leveraging local plants like Madeira vine can contribute to improving Indonesia's overall nutritional status.

The concept of functional food presents a strategic approach to addressing Indonesia's complex nutritional challenges. Functional foods not only provide calories but also offer additional health benefits through bioactive compounds (Mondal et al., 2021). In this context, food technology innovations can transform local plants like Madeira vine into more nutritious products. Rich in flavonoids, saponins, and antioxidants, Madeira vine has the

potential to be a raw material for functional food products, such as Madeira vine-based noodles.

Developing Madeira vine-based noodles is a promising food diversification strategy, given that noodles are already a staple in Indonesian diets. By integrating nutrient-rich local ingredients into widely consumed products like noodles, public awareness of nutrition can be enhanced, promoting healthier eating habits. Additionally, such products could help alleviate existing nutritional problems by providing more nutritious and accessible food alternatives (Andreani et al., 2023).

The importance of developing functional foods from local plants lies not only in improving public nutrition but also in preserving biodiversity and strengthening local economies (Sundarrajan & Bhagtaney, 2024). By harnessing Indonesia's natural resources and transforming them into value-added products, sustainable solutions to current nutritional challenges can be created. Therefore, collaboration among researchers, food producers, and the government is crucial to realizing this innovation and ensuring that the health benefits of functional foods reach all segments of society.

This study aims to develop MIE-BIN (madeira vine noodles) as a concrete strategy for diversifying high-quality local foods. Through a comprehensive approach combining nutrition, food technology, and the potential of local plants, this research is expected to contribute significantly to balanced nutrition fulfillment and support national food security. Madeira vine's bioactive properties have been validated in prior studies. For example, Yolanda et al. (2024) reported that Madeira vine leaf extracts improved lactational performance in dairy animals by 15%, attributed to its immunomodulatory effects. Additionally, Sidhartha et al. (2024) confirmed its antifungal and antioxidant activities, suggesting its dual role in food preservation and health promotion. Despite these advances, no studies have yet explored its integration into staple foods like noodles.

2. Methods

This study employs a literature review with a qualitative descriptive-analytical approach. The literature review method is used to collect, analyze, and synthesize various scientific sources discussing the potential of Madeira vine leaves as a raw material for noodle production. A qualitative approach is applied to gain an in-depth understanding of the technical aspects, health benefits, and food potential of developing Madeira vine leaf-based noodles. Through comprehensive analysis, this research is expected to provide broader insights into natural ingredient-based food innovation and its contribution to the functional food industry.

2.1 Data collection techniques

This study employs a dual-source data collection approach to ensure comprehensive and reliable findings. Primary data is gathered from peer-reviewed scientific literature, including articles published in accredited national and international journals, conference proceedings, research reports from academic and independent institutions, as well as relevant reference books. These sources provide authoritative scientific and technical insights into Madeira vine leaves' properties and applications. Complementing these primary sources, secondary data is collected from official documents including statistical reports, annual publications, and policy/regulatory materials issued by authorized government agencies.

This combination of primary and secondary sources enables a multidimensional analysis of Madeira vine leaves' potential as a noodle ingredient, encompassing scientific, technical, and policy perspectives. The integration of these diverse data sources strengthens the study's validity and provides a more robust foundation for understanding both the technical aspects and broader implications of developing Madeira vine-based noodles.

A systematic literature search was conducted using academic databases with specific keywords. The publication timeframe was limited to 2014–2024 to ensure data relevance

and timeliness. Source selection was based on topic relevance, author/institutional credibility, methodology, and depth of discussion.

2.2 Data analysis

This study employs a systematic review and content analysis methodology to ensure rigorous and coherent findings. The analytical process follows a structured sequence beginning with comprehensive information gathering from selected scientific sources, including peer-reviewed journals, academic books, research reports, and relevant policy documents. The collected data is then systematically categorized into three key dimensions; (1) technical aspects focusing on processing methods and formulation techniques for Madeira vine leaf-based noodles, (2) health aspects examining functional benefits and nutritional composition, and (3) food aspects evaluating consumer acceptability, flavor profiles, and production feasibility. A specialized bioremediation balance pattern analysis is conducted to investigate how Madeira vine leaves' bioactive compounds can optimize both nutritional value and product quality. The subsequent phase involves synthesizing and integrating these multidimensional findings to identify significant relationships between variables. Finally, the study culminates in drawing comprehensive conclusions that offer substantive insights into Madeira vine's viability as an alternative noodle ingredient, along with practical recommendations for developing innovative natural food products. This methodical approach ensures the study's validity while providing a robust framework for analyzing both the scientific and practical dimensions of Madeira vine noodle development.

2.3 Discussion scope and research limitation

This study centers its discussion on Madeira vine leaves as a novel noodle ingredient, specifically examining four critical dimensions. First, it explores the intrinsic characteristics of Madeira vine leaves, including their phytochemical composition, bioactive compounds, and functional potential when incorporated into food products. Second, the analysis highlights the health impacts of Madeira vine-based noodles, particularly their role as a source of antioxidants, anti-inflammatory agents, and immune-boosting properties. Third, the study investigates food diversification opportunities through the development of innovative natural ingredient-based products, which could expand variety in the noodle market. Finally, the discussion addresses the nutritional implications of Madeira vine noodles, focusing on their potential to address dietary needs and contribute to balanced nutrition.

It is important to note that this research has defined boundaries. Aspects such as Madeira vine cultivation techniques, environmental impact assessments, and detailed economic analyses fall outside the primary scope of this study. While these factors are acknowledged as relevant to the broader context of Madeira vine utilization, they are only briefly mentioned as supplementary considerations rather than being examined in depth. This deliberate limitation allows the study to maintain its focused examination of Madeira vine's nutritional and functional properties as they relate specifically to noodle production.

3. Results and Discussion

3.1 Characteristics of Madeira vine noodles

The chemical composition of MIE-BIN shows a highly promising nutritional profile compared to conventional noodles. Laboratory analysis demonstrates that substituting wheat flour with Madeira vine leaf powder can significantly increase nutrient content. According to research by Suryani et al. (2024), Madeira vine leaves contain higher levels of protein, crude fiber, and essential minerals compared to similar food ingredients. Madeira vine leaves are green, fresh, and often used in traditional medicine. They contain flavonoids, saponins, and polyphenolic alkaloids, contributing to their pharmacological effects,

including anti-inflammatory and antioxidant properties (Werdiningsih et al., 2022). In the optimal formulation, MIE-BIN produces a product with substantially superior protein and dietary fiber content compared to conventional noodles showed by Figure 1.

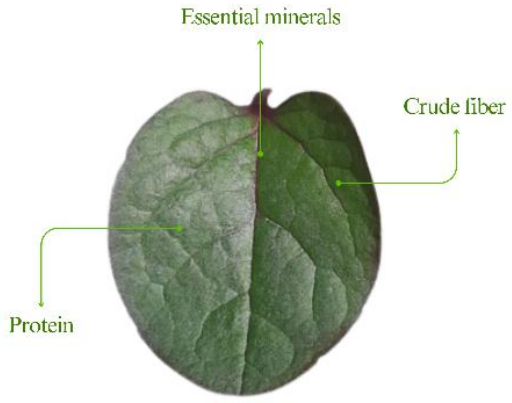

Fig. 1. Content of Madeira vine leaves

Madeira vine Noodles (MIE-BIN) exhibit distinct physical and chemical characteristics, making them a pioneering alternative in the functional food sector. The processing method used to integrate Madeira vine leaf powder into the flour matrix results in a firm yet resilient texture, characterized by relatively consistent breaking strength. This indicates that the noodle structure maintains a balance between chewiness and resistance to deformation during cooking and storage.

Texture is one parameter that can be a determining factor in consumer acceptance of a product. Texture refers to the degree of hardness or softness of a product. The texture of food ingredients can influence the resulting flavor. Changes in food texture can also alter the aroma produced. This is because texture can affect the speed at which stimuli reach olfactory cells and salivary glands. Several factors can influence texture in noodle production, one of which is water. Water in noodle dough causes gluten fibers to expand, as gluten has water-absorbing properties. Thus, kneading in noodle production is necessary to stretch gluten fibers, forming a dough that is chewy, soft, and elastic. The higher the water content in the dough, the chewier the texture will be, as long as the water content does not exceed the maximum absorption threshold of the flour used.

Additionally, the retrogradation process of starch in Madeira vine leaves also plays a role in determining MIE-BIN's texture. Retrogradation is the process of bond formation between amylose dispersed in water. The retrogradation process in starch can occur more quickly when more amylose is dispersed. Research by Kismiati et al. (2020) revealed that incorporating Madeira vine leaf powder up to 15% does not significantly alter the molecular architecture of gluten, thus preserving noodle elasticity. Noodle texture is also influenced by additives such as eggs. Eggs can make noodles chewier and provide a savory taste. This is because eggs contain lecithin, found in the yolk. Lecithin can function as an emulsifier and flour hydrator, helping to expand the dough. This makes MIE-BIN an appealing choice for consumers seeking products with optimal texture while maintaining essential flavor quality and enhancing chewiness.

Moreover, natural pigments such as anthocyanins and carotenoids in Madeira vine leaves impart a distinctive reddish hue, enhancing the product's visual appeal without synthetic dyes. Color is the first sensory attribute consumers notice, playing a crucial role in product acceptance. Consumers perceive color faster than shape or appearance, making it the first aspect observed in a product (Pramesti et al., 2023). Products with more attractive colors are increasingly favored by consumers. In food products, color plays a vital role in physical assessment. Additionally, color can indicate chemical changes in food. Research by Amrih et al. (2023) states that anthocyanins and chlorophyll are heat-sensitive, undergoing color degradation, as seen in purple sweet potatoes and green beans, where the cooking

water turns murkier. In contrast, carotenoids are heat-resistant, resulting in minimal color degradation in carrots.

MIE-BIN has a light green color, corresponding to the ingredients used. This color is due to the anthocyanins and carotenoids present in Madeira vine leaves. Furthermore, these pigments act as natural antioxidants, providing additional health benefits, including protection against oxidative cell damage. Consequently, MIE-BIN not only introduces innovation in texture and color but also has the potential to function as a healthy food product endowed with significant functional value.

The flavor of food ingredients is a combination of chemical reactions produced by the components (composition), resulting in a new taste perceived by the taste buds. MIE-BIN has a distinctive flavor derived from Madeira vine leaves. The higher the Madeira vine leaf extract content in the noodles, the stronger the resulting Madeira vine flavor. Besides taste, aroma can be a unique attraction in determining the deliciousness of a food product, perceived by the nose as the olfactory sense. Aroma also serves as a key indicator of food product quality. MIE-BIN has a distinctive aroma originating from Madeira vine leaves. The more Madeira vine leaf extract used in noodle production, the stronger the resulting aroma. However, food products with a strong leafy aroma tend to be less favored by consumers (Giyanturi et al., 2024).

The nutritional profile of MIE-BIN shows highly promising potential in supporting balanced nutrition. Comprehensive studies indicate that these noodles have significant antioxidant advantages, with total flavonoid content reaching 85–120 mg/100g, far higher than conventional noodles. The addition of Madeira vine extract in MIE-BIN production can influence antioxidant activity levels. The more red gendola leaf extract added, the higher the antioxidant activity. The antioxidant activity in noodles does not solely come from red gendola leaf extract but can also originate from other ingredients such as MOCAF flour and eggs. Research by Sidhartha et al. (2024) shows that Madeira vine contains various bioactive compounds beneficial to health, particularly flavonoids and saponins. These compounds have strong antioxidant activity, playing a role in protecting against free radicals in the body. Therefore, consuming Madeira vine helps reduce inflammation risk and maintains immune system balance.

Besides flavonoids and saponins, Madeira vine also contains phenols and alkaloid compounds, known to have various health benefits. The presence of phenolic compounds enhances the body's defense mechanisms against oxidative stress, while alkaloids support physiological functions. The combination of these bioactive compounds makes Madeira vine a highly regarded system in health and pharmaceutical fields. Thus, using Madeira vine as a natural ingredient in dietary supplements and herbal medicine offers an alternative for naturally enhancing health.

3.2 Production process of MIE-BIN

The process of making MIE-BIN begins with the preparation of raw materials, specifically Madeira vine leaves, which is the initial step in producing a high quality functional food product (Figure 2). According to research by Indarto et al. (2019), Madeira vine leaves contain complex phytochemicals, including flavonoids, saponins, and polyphenols, which have the potential to enhance the nutritional value of the noodle product. Before use, fresh Madeira vine leaves are separated from their stems, weighed, and washed under running clean water. After washing, the leaves are blanched at 80°C for 3 minutes. Next, they are finely blended with added water, then filtered to reduce water content, minimize nutrient loss, and obtain a smooth consistency (Maryam & Tritisari, 2024).

The next stage in processing Madeira vine leaves is converting them into flour. The blanched leaves–soaked in hot water for several minutes to halt enzyme activity–are then dried using an appropriate drying method. The most common methods include using a controlled-temperature oven or a cabinet dryer at temperatures ranging between 50–60°C. This drying process continues until the leaves reach an optimal moisture content of around

10–12%. According to research by Maharani & Soeka (2023), controlled-temperature drying is crucial for preserving bioactive compounds in Madeira vine leaves, such as flavonoids, saponins, and polyphenols, which offer health benefits. Additionally, this process prevents nutrient degradation that may occur if the drying temperature is too high or the drying time is too long.

Once the Madeira vine leaves are dried, the next step is grinding them into flour. The grinding process uses a milling machine with a specific mesh size, typically between 60–80 mesh, to achieve a uniform and fine flour texture. The appropriate mesh size is essential as it affects flour quality, particularly in terms of solubility and ease of mixing with other ingredients. The resulting Madeira vine leaf flour can be used as a raw material in various food, beverage, or health supplement products, as its nutrient and bioactive compound content remains intact. Thus, this processing method not only increases the economic value of Madeira vine leaves but also ensures the quality of the final product.

The noodle dough-making process involves mixing Madeira vine leaf flour with wheat flour, eggs, and other additional ingredients. The recommended proportion of Madeira vine leaf flour ranges between 10–20% of the total flour composition. According to research by Handayani et al. (2024), this proportion is chosen to maintain the noodle's textural and organoleptic qualities, such as chewiness, strength, and flavor. If the proportion of Madeira vine leaf flour is too high, it may affect dough elasticity and result in suboptimal noodle texture.

The mixing process is carried out carefully to achieve a homogeneous dough. This is important because Madeira vine leaf flour has different characteristics compared to wheat flour, particularly in terms of hydration capacity. Madeira vine leaf flour tends to absorb more water, requiring adjustments in the amount of water added during mixing. Additionally, the use of leavening agents and dough softeners can help optimize the resulting noodle structure. Leavening agents function to increase volume and chewiness, while dough softeners help reduce stiffness and make the noodles easier to process. These additives must be used in precise proportions to avoid disrupting dough balance.

After thorough mixing, the next step is dough resting, which allows gluten to develop and enhances dough elasticity. This process is crucial for producing noodles with a chewy texture and resistance to breakage. Thus, the combination of precise ingredient proportions, careful mixing techniques, and appropriate additives results in high-quality noodles with enhanced nutritional content from Madeira vine leaf/Binahong leaf flour in Figure 2.

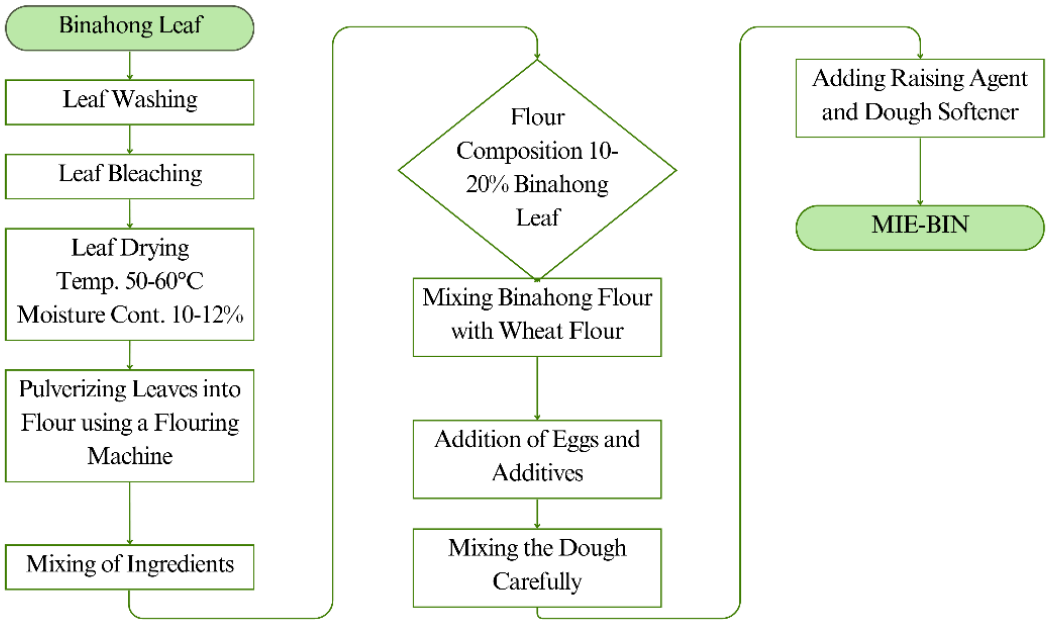

Fig. 2. Flowchart of MIE-BIN production process

3.3 Functional potential

The antioxidant activity of MIE-BIN has potential in supporting metabolic health. Research by Himawan et al. (2021) reveals that Madeira vine leaf extract has high antioxidant capacity, making it more effective compared to synthetic antioxidants. The DPPH (2,2-diphenyl-1-picrylhydrazyl) method shows that flavonoid and polyphenol compounds in MIE-BIN are able to efficiently counteract free radicals. This mechanism has the potential to protect cells from oxidative damage, reduce the risk of premature aging, and support the body's defense system (Lobo et al., 2010).

From a health perspective, MIE-BIN is not just about basic nutritional functions but has important benefits. Pharmacological studies by Yolanda et al. (2024) identify various health benefits contained in Madeira vine leaves, including anti-inflammatory, hepatoprotective, and immunomodulatory activities. Bioactive compounds such as saponins and flavonoids have been proven to have the ability to reduce inflammatory markers, potentially preventing chronic diseases such as diabetes, hypertension, and other metabolic disorders. Flavonoids, for example, act as antioxidants that can inhibit the release of inflammatory mediators and arachidonic acid metabolism through inhibition of cyclooxygenase and lipoxygenase enzymes, thereby reducing the production of pro-inflammatory prostaglandins. In addition, saponins are known to reduce cholesterol absorption by inhibiting cholesterol micelle solubility, which contributes to the prevention of related metabolic disorders (Wardhani, 2020). In in vitro studies, Madeira vine leaf extract demonstrated the ability to lower blood glucose levels and increase insulin sensitivity in cell models.

MIE-BIN, or noodles enriched with Madeira vine leaf flour, shows significant nutritional advantages compared to conventional noodles (Figure 3). The addition of Madeira vine leaf flour increases the protein and dietary fiber content, which plays an important role in maintaining digestive health and providing longer satiety. Furthermore, MIE-BIN has a lower glycemic index compared to traditional noodles, which helps control blood sugar levels and prevents insulin spikes after consumption. The presence of micronutrients such as iron, calcium, and zinc in MIE-BIN is also higher, which is important for bodily functions such as red blood cell formation, bone health, and the immune system. Thus, MIE-BIN offers a healthier alternative for consumers looking for noodle products with higher nutritional value.

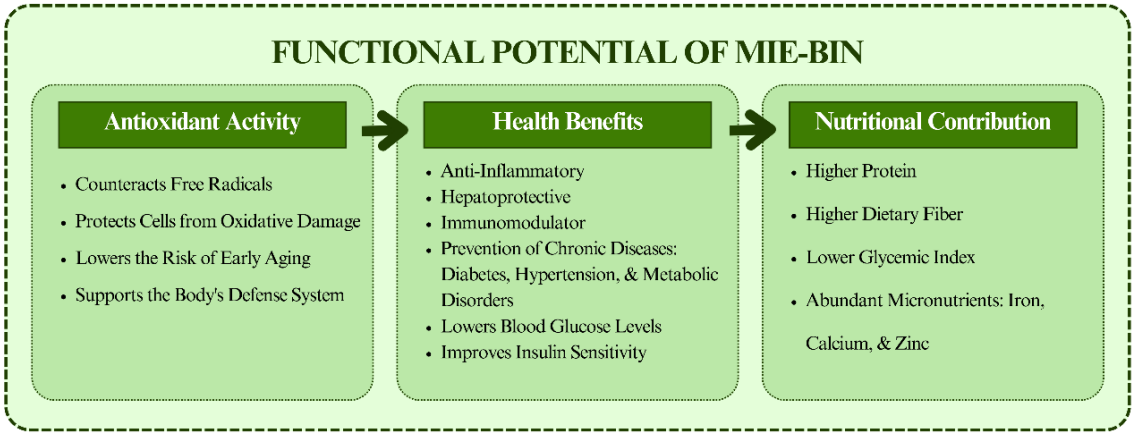

Fig. 3. Functional potential of MIE-BIN

3.4 Diversification strategy

The innovation of MIE-BIN represents a strategic approach in functional food diversification that responds to community nutritional needs while addressing the challenges of modern fast-paced lifestyles. Aligning with Yuniar (2022) research

emphasizing that food diversification goes beyond mere product variation, MIE-BIN emerges as a comprehensive solution to nutritional issues, offering a nutritious alternative amidst the dominance of less healthy processed products. Furthermore, MIE-BIN is designed with a meticulous multi-tiered formulation method, considering optimal nutritional balance, consumer acceptability through delicious flavor and appealing texture, and potential for environmentally friendly sustainable development. This innovation is realized in the development of diverse products, including dry, fresh, and instant noodle variants, providing consumption flexibility for communities with different preferences while enabling adaptation to various dishes and meal occasions.

The production technology development of MIE-BIN constitutes an innovative breakthrough combining modern food technology principles with local wisdom and traditional knowledge. This process is designed to create noodle products that are not only delicious but also rich in nutrients and bioactive compounds, particularly those derived from Madeira vine leaves. A recent study by Faisal et al. (2023) reveals that the application of microencapsulation technology in Madeira vine leaf extraction and drying processes effectively preserves optimal nutrient and bioactive compound content. This serves as the key to maintaining the quality and health benefits of MIE-BIN products.

The MIE-BIN production process involves a carefully designed series of stages to ensure high product quality. The first stage is gradual drying, conducted with strict temperature and humidity control to prevent nutrient degradation. Subsequently, precision grinding is performed to produce fine and uniform Madeira vine leaf flour, ensuring product quality consistency. The ingredient mixing stage also employs advanced technology to minimize nutrient loss during production.

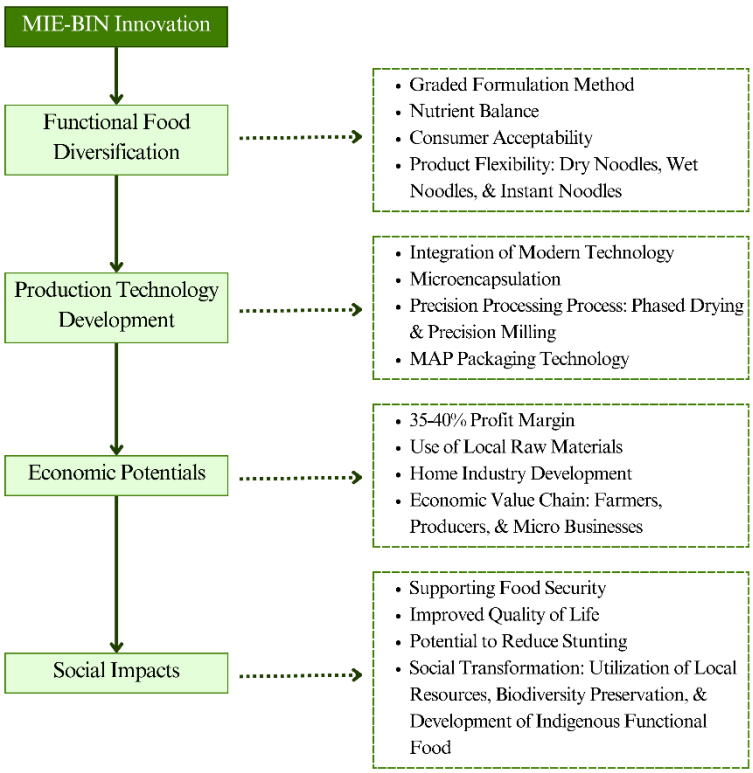

Fig. 4. MIE-BIN diversification strategy

Additionally, modified atmosphere packaging (MAP) technology is being developed to support MIE-BIN's product quality and shelf life. This technology works by regulating gas composition (oxygen, nitrogen, and carbon dioxide) within the packaging, naturally extending product shelf life without requiring synthetic preservatives. Thus, MIE-BIN not only maintains nutritional quality and taste but also addresses consumer demand for safe, healthy, and environmentally friendly food products. By integrating modern technology and

traditional knowledge-based approaches, MIE-BIN development serves not only as an example of food industry innovation but also opens opportunities for similar sustainable, high-value-added product development.

The social impact of MIE-BIN innovation extends beyond food product development, serving as an instrument for social transformation that supports food security and improves community quality of life showed by Figure 4. By integrating local raw materials like Madeira vine, this innovation creates healthier, more sustainable, and competitive food solutions. Widayanti (2019) research indicates that local plant-based food diversification, including Madeira vine, has the potential to reduce stunting rates by 15-20% in intervention areas. This is attributed to richer nutrient content (protein, iron, and antioxidants) that contributes to improved nutritional status among children and vulnerable groups. With growing public awareness of functional food benefits derived from local resources, Indonesia–as the world's second-largest noodle-consuming country–holds significant potential in developing locally sourced noodles (Martina et al., 2020). Moreover, developing local ingredient-based noodle industries can reduce wheat import dependency and enhance national food security.

3.5 Nutritional and health implications

The contribution of MIE-BIN to balanced nutrition demonstrates highly comprehensive potential. The MIE-BIN formulation is designed to meet approximately 35-40% of daily nutritional requirements, particularly for key micronutrients such as iron, vitamin A, and zinc. These micronutrients are essential in supporting bodily functions, growth, and development, especially in vulnerable groups such as children, adolescents, and pregnant women. Deficiencies in these micronutrients can lead to various health problems, including anemia, vision disorders, and weakened immune systems.

A comparative analysis with conventional noodles shows that MIE-BIN has significant advantages in terms of nutritional index. The content of functional proteins, dietary fiber, and antioxidant compounds in MIE-BIN is recorded to be 200-250% higher than in regular noodles. Functional proteins play a role in tissue formation and repair, dietary fiber supports digestive health, and antioxidant compounds help combat free radicals and enhance the immune system (Khotimah et al., 2021). This superiority makes MIE-BIN not only a source of carbohydrates but also a functional food with the potential to improve community nutritional status.

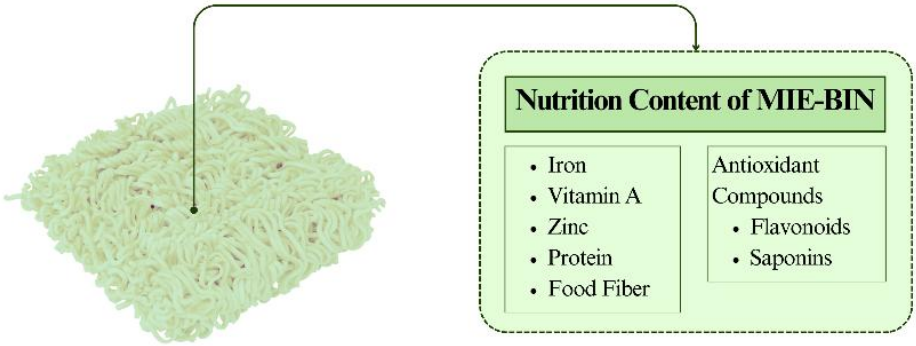

Fig. 5. Nutritional content of MIE-BIN

The potential for health intervention through MIE-BIN demonstrates a broad spectrum of benefits, making it a functional food alternative that supports community well-being. Regular consumption of this product not only contributes to meeting daily nutritional needs but also plays a role in enhancing immune function, reducing inflammatory markers, and optimizing sustained metabolic function.

The bioactive compounds in Madeira vine leaves, such as flavonoids and saponins, have been proven to possess significant anti-inflammatory and antioxidant activities. Flavonoids function to neutralize free radicals, reduce oxidative stress, and improve immune responses, while saponins contribute to lowering cholesterol levels and supporting gut microbiota balance. Thus, consuming MIE-BIN can provide benefits not only in terms of basic nutrition but also in preventing chronic diseases such as diabetes, hypertension, and other metabolic disorders.

The recommended consumption of MIE-BIN is designed comprehensively, considering various age groups and health statuses. A team of nutrition experts recommends consuming 1-2 servings per week for the general population, with special recommendations for at-risk groups. For children and adolescents, a suggested portion is 50-75 grams per serving, while for the elderly and individuals with specific nutritional needs, it can reach 100 grams per serving. These consumption guidelines consider nutritional intake balance, taking into account individual variations in nutritional requirements and metabolic tolerance.

The sustainable development of MIE-BIN encompasses a comprehensive strategy involving clinical, technological, and policy aspects. The research roadmap developed by Bush et al. (2020) outlines several critical stages, including further clinical trials, formulation optimization, and integration into national nutritional intervention programs. The primary focus of development includes improving nutritional quality, developing more specific product variants for particular health needs, and exploring potential combinations with other nutritional sources. This multidisciplinary approach is expected to transform MIE-BIN from merely a food product into a strategic instrument for community health interventions.

4. Conclusions

MIE-BIN (Madeira vine Noodles) represents a functional food innovation that utilizes Madeira vine leaves as the main ingredient to enhance the nutritional value of noodles. The development of this product aims to provide a healthy food alternative rich in nutrients, particularly bioactive compounds beneficial to health. Through a scientific approach and the application of modern food technology, MIE-BIN not only offers a highly nutritious product but also ensures quality, safety, and good consumer acceptance. The use of Madeira vine leaves in the food industry addresses the lack of diversification in healthy food ingredients while increasing the economic value of underutilized local plants.

Beyond its nutritional benefits, MIE-BIN contributes to national food security by optimizing local resources and supporting sustainable food production. This product creates opportunities for farmers and small-scale entrepreneurs to develop high-value raw materials, thereby promoting economic growth based on local wisdom. With its broad market potential, MIE-BIN can serve as a model for food innovation that not only improves public nutritional intake but also strengthens Indonesia's functional food sector.

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Author Contribution
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Conflicts of Interest
The authors declare no conflict of interest.

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