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4K Mokaya: Innovative Seri Kaya for Vegetarians

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Abstract: Moringa, also known as drumstick tree, is a plant well-known for its rich nutritional profile and has been the subject of numerous studies exploring its potential health benefits. This study focuses on the innovation of a new food product, Mokaya, a combination of the names Moringa and Seri Kaya, which has been developed to cater to vegetarian diets using entirely plant-based ingredients. The Moringa plant, often referred to as the miracle tree, is incorporated into the Seri Kaya formulation to create Mokaya, which is not only delicious but also packed with nutrients. The main objective of this study is to develop a vegetarian-friendly Seri Kaya that maximizes the nutritional benefits of Moringa. The process involves using Moringa leaves and its fruit as the main ingredients in the production of Mokaya. Other plant-based ingredients are carefully selected to complement Moringa's nutritional profile while ensuring the product meets vegetarian dietary restrictions. The final product undergoes evaluation to assess its acceptability in terms of taste, texture, and overall satisfaction. Furthermore, the innovation of using Moringa as a key ingredient in the making of Seri Kaya not only opens up new culinary possibilities but also provides a functional food product that supports overall health and well-being. This study highlights the potential of incorporating Moringa into various food products to enhance nutrition and promote healthier eating habits among vegetarians.

Keywords: Healthy food, innovation, moringa, seri kaya, vegetarian diet

1. Introduction

In recent years, the global trend towards plant-based diets has gained significant momentum, driven by increasing awareness of the health benefits, environmental sustainability, and ethical considerations associated with reducing the consumption of animal products (Sandua, 2024). As more individuals adopt a vegan lifestyle, the demand for innovative and nutrient-dense plant-based foods has risen. Meeting the nutritional needs of vegetarians, who often face challenges in obtaining essential nutrients typically found in animal products, requires the innovation of new food products that are both delicious and nutritionally rich (Alcorta et al., 2021). Moringa oleifera, commonly known as Moringa, drumstick tree, or ramunggai, has emerged as a plant that can add nutritional value to diets. Often referred to as the "miracle plant," Moringa was chosen for its exceptional nutritional profile, offering complete nutrients and proteins. This study introduces Mokaya, an innovative food product that combines Moringa with Seri Kaya, a spread that uses Moringa powder and coconut milk. Mokaya is a plant-based reimagining of Seri Kaya, ensuring it aligns with vegetarian dietary restrictions while maximizing the nutritional benefits of Moringa.

By incorporating Moringa into the formulation of Seri Kaya, Mokaya offers a unique blend of taste and nutrition, providing vegetarians with a functional food product that supports overall health and well-being (Vrgović et al., 2022). The production process involves using Moringa leaves and fruit as the main ingredients, complemented by other carefully selected plant-based components. The final product undergoes rigorous evaluation to assess its acceptability in terms of taste, texture, and overall satisfaction among consumers. This innovation not only opens up new culinary possibilities but also addresses common nutritional deficiencies observed in vegetarian diets. Despite the increasing popularity of meat-free diets among vegetarians, this group often struggles to meet their nutritional needs due to the limited availability of nutrient-dense plant-based food products. Traditional vegetarian diets can experience deficiencies in essential vitamins, minerals, and proteins typically found in animal-based foods, leading to potential nutritional gaps and health issues (Tallman et al., 2023). Additionally, the food industry has yet to innovate sufficiently to create appealing, nutritious, and convenient vegetarian options that meet the demands of this diet.

Moringa offers a solution to these challenges due to its exceptional nutritional profile (Horn et al., 2022). However, its integration into mainstream vegetarian food products has been limited. Seri Kaya, a traditional sweet and creamy

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spread made with coconut milk, eggs, and sugar, is widely enjoyed but traditionally made with animal-derived ingredients, making it unsuitable for vegetarians. The problem addressed by this research is the need to develop a plant-based food product that is nutritious, delicious, and fully leverages the health benefits of Moringa while meeting the dietary preferences and requirements of vegetarians. This involves innovating a new formulation of Seri Kaya, called Mokaya, which incorporates Moringa leaves and fruit without using eggs, ensuring consumer acceptance in terms of taste, texture, and overall satisfaction. The goal is to create a functional food product that not only appeals to vegetarians but also helps address common nutritional deficiencies in their diet, promoting healthier eating habits and overall well-being.

Therefore, this study aims to achieve three main objectives: first, to develop a vegetarian-friendly Seri Kaya product that maximizes the nutritional benefits of Moringa oleifera; second, to create a nutrient-dense Mokaya spread suitable for vegetarians by incorporating Moringa leaves and fruit as key ingredients; and third, to evaluate the acceptance of the Mokaya product in terms of taste, texture, color, and overall consumer satisfaction

2. Literature Review

According to (Islam et al., 2021) previous studies have shown that Moringa oleifera is a plant with a highly rich nutritional profile and numerous health benefits. Moringa leaves contain all nine essential amino acids required by the human body, making it a potential protein source for plant-based diets. This can help address the issue of protein deficiency in vegetarian diets (Leone et al., 2016). Additionally, Moringa leaves are rich in antioxidants such as flavonoids, polyphenols, and ascorbic acid, which are crucial for protecting the body from oxidative damage and reducing the risk of chronic diseases (Saini et al., 2016).

A study by (Gopalakrishnan et al.,2016) highlighted that Moringa contains high levels of vitamins A, C, and E, as well as minerals such as calcium, potassium, and iron. These nutrients are essential for immune system function, bone health, and the prevention of anemia. Additionally, the bioactive components in Moringa, such as isothiocyanates, are associated with anti-inflammatory properties that can help reduce inflammation and lower the risk of chronic diseases such as arthritis and heart disease (Stohs & Hartman, 2015). Innovation in vegetarian food products continues to advance, focusing on enhancing nutritional value and taste to meet the growing demand for plant-based diets (Sharma et al., 2024). Plant-based meat products, such as vegetable burgers and sausages, have become increasingly popular as they provide protein-rich alternatives to meat while being low in saturated fat, making them a healthy choice for vegetarians (Sha et al., 2020). Plant-based dairy alternatives, including almond milk, soy milk, and oat milk, have also gained popularity, offering lactose-free options that are rich in calcium and vitamin D, which are crucial for bone health (Sousa et al., 2020). Furthermore, innovations in vegetarian spreads and sauces, such as nut butters, hummus, and now Mokaya based on Moringa, provide tasty and nutrient-dense alternatives to conventional products that use animal-derived ingredients (Asgar et al., 2018). The integration of Moringa into vegetarian food products like Mokaya not only provides nutritional benefits but also meets strict dietary requirements. Using Moringa in formulations such as Seri Kaya ensures that the product is not only nutrient-rich but also appealing in terms of taste and texture. Incorporating Moringa into food products can enhance nutritional value without compromising flavor, and Moringa-based foods can help address micronutrient deficiencies among vegetarians, making it a crucial component in food innovation (Leone et al., 2016; Gopalakrishnan et al., 2016).

A comprehensive literature review indicates that Moringa oleifera holds significant potential for use in vegetarian food product innovation. Its extensive nutritional benefits, combined with the growing trend towards plant-based diets, make Moringa an ideal candidate for development in products like Mokaya. This study not only contributes to enhancing the health and well-being of vegetarians but also paves the way for further innovation in the plant-based food industry.

3. Methodology

This study employs an experimental approach to develop and evaluate 4K Mokaya, an innovative vegetarian-friendly Seri Kaya product.

The first step in the production process involves the collection and preparation of raw materials. Moringa leaves and fruit are cleaned and dried before being processed into a powder. This Moringa powder is then mixed with other ingredients according to predetermined ratios. The mixture is heated and stirred until the desired texture is achieved. The final product is then placed into sterilized storage containers to ensure food quality and safety as shown in Fig.1.

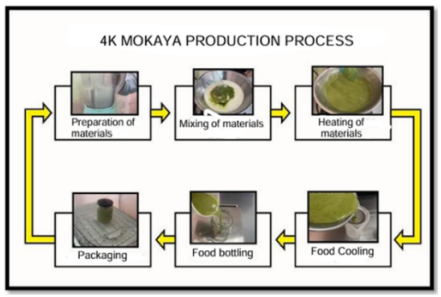

Fig. 1 - Production workflow for 4K mokaya.

The production process for 4K Mokaya begins with the preparation of ingredients, where key components such as Moringa oleifera leaves and fruit are cleaned and prepared. Next, the prepared ingredients are mixed together in specified ratios. The mixture is then heated and stirred until the desired texture is achieved. After heating, the mixture is allowed to cool before proceeding to the next step. The cooled mixture is transferred into sterilized containers or bottles to ensure food quality and safety. Finally, the finished product is carefully packaged for storage and distribution.

Product evaluation was conducted through sensory assessment by 45 respondents, consisting of students and members of the public participating in a community college promotion program. Respondents assessed aspects such as taste, texture, color, and overall satisfaction of the product using a rating scale. Data were collected through a questionnaire provided to the respondents. Quantitative data were analyzed using statistical software to determine the level of product acceptance. The questionnaire aimed to gather information on the acceptance and effectiveness of the innovative 4K Mokaya, a vegetarian-friendly Seri Kaya. 4K Mokaya was developed by incorporating entirely plant-based ingredients, primarily Moringa oleifera leaves and fruit, known for their rich nutritional profile and various health benefits. The study aimed to assess the taste, texture, color, and overall user satisfaction with the product. The questionnaire consisted of two main sections. Section A, gathered demographic information from respondents, such as age, gender, employment status, and highest level of education. Section B, asked respondents to evaluate various aspects of 4K Mokaya using a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree." Aspects assessed included taste, texture, color, and overall satisfaction.

The data collected through this questionnaire are crucial for future product improvement. Data analysis will be conducted using statistical software to identify patterns and correlations between respondents' demographic information and their level of satisfaction with the 4K Mokaya product. This methodology is designed to provide a comprehensive evaluation of the 4K Mokaya product, allowing for enhanced product development based on user feedback.

4. Results and Discussion

4.1 Cronbach's Alpha Value

The obtained Cronbach's Alpha value is 0.835, indicating a high level of internal reliability for the questionnaire. This means that the items in the questionnaire are consistent, and the collected data can be trusted. This value is important because it ensures that the study results are accurate and can be used to make informed decisions regarding product improvements and marketing strategies. In the context of the study "4K MOKAYA: Innovative Seri Kaya for Vegetarians," this result suggests that the aspects of taste, texture, color, and overall user satisfaction were measured effectively, aiding efforts to enhance the product.

4.2 Demographic Analysis

Demographic data shows diverse participation in terms of age, with the 30-39 age category having the highest number of respondents at 12 as presented in Table 1. This is followed by 10 respondents under 20 years old, indicating significant interest from younger individuals. The 20-29 and 40-49 age categories each have 8 respondents, reflecting balanced engagement from both of these age groups. The 50 and over group has the lowest number of respondents, at 7. The age distribution graph indicates that the study has garnered perspectives from a range of age groups as shown in Fig.2. In conclusion, the study received good participation from all age groups, with a primary focus on young and middle-aged adults.

Table 1 - Age of respondents.

Category	Number of Respondents
Under 20 years	10
20-29 years	8
30-39 years	12
40-49 years	8
50 years and above	7

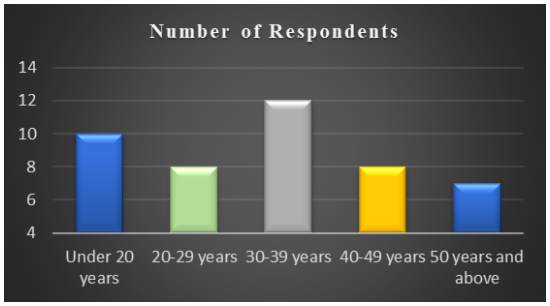

Fig. 2 - Age of respondents.

The demographic data shows that there are 23 male respondents and 22 female respondents as shown in Fig. 3. This indicates an almost equal participation between males and females in this study. The graph of the number of respondents by gender shows a slight difference, with slightly more males than females. Although there is a small difference, the participation from both genders is nearly balanced. This ensures that the views and feedback from both males and females are considered in this study. In conclusion, this study has received valuable input from both genders, providing a more comprehensive view on the acceptance of the 4K Mokaya product.

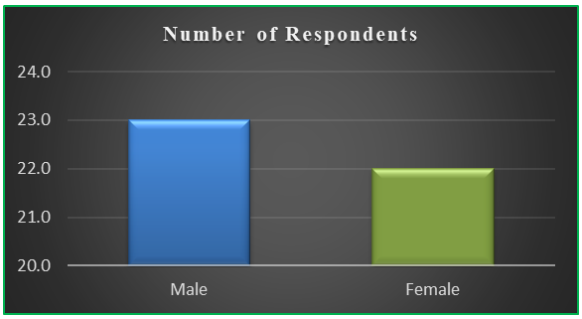

Fig.3 - Respondent's gender.

4.3 Product Evaluation Analysis

A Product Evaluation Analysis for 4K Mokaya involves a comprehensive assessment of the product to determine its effectiveness and appeal compared to traditional Seri Kaya. This analysis covers five main aspects.

4.3.1 Taste Aspect

The overall mean values for the taste aspect indicate that respondents are generally satisfied with the flavor of the evaluated product. Questions Q1 and Q2, with the highest mean values of 4.02, show that the 4K Mokaya product is considered delicious and well-liked by respondents. Questions Q3 and Q4, each with a mean value of 4.00, suggest that the taste of this product is consistent and regarded as unique and appealing. Although Question Q5 has a slightly lower mean value of 3.98, it still indicates that the taste of this product is considered better compared to similar products on the market. Overall, the high and consistent mean values reflect positive satisfaction and acceptance of the product's taste as presented in Table 2. The provided bar chart clearly illustrates the mean values for each question, reinforcing the interpretation that the product's flavor is well received by users as shown in Fig. 4.

Table 2 - Taste aspect.

Number of questions	**Item**	**Mean**
Q1	The 4K Mokaya product has a delicious taste.	4.02
Q2	I like the taste of the 4K Mokaya product.	4.02
Q3	The taste of this product is consistently enjoyable every time I try it.	4.00
Q4	This product has a unique and intriguing flavor.	4.00
Q5	The taste of this product is considered superior compared to similar products.	3.98

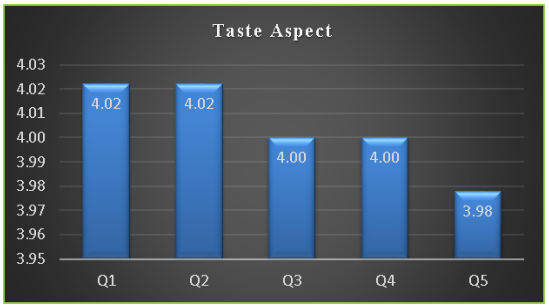

Fig. 4 - Taste aspect.

4.3.2 Texture Aspect

The overall mean values for the texture aspect indicate that respondents are generally satisfied with the evaluated product. Questions Q6 and Q7, each with the highest mean value of 4.02, show that the texture of this product is considered very suitable, satisfying, and consistent. Questions Q8 and Q9, both with a mean value of 4.00, confirm that respondents like the product's texture and feel it enhances their overall experience. Although Question Q10 has a slightly lower mean value of 3.98, it still indicates that the texture of this product is regarded as better compared to similar products on the market as presented in Table 3. Overall, these high and consistent mean values reflect positive satisfaction and acceptance of the product's texture as shown in Fig. 5.

Table 3-Texture aspect

Number of questions	**Item**	**Mean**
Q6	The texture of this product is very suitable and satisfying.	4.02
Q7	This product has a consistent texture.	4.02
Q8	I like the texture of the 4K Mokaya product.	4.00
Q9	The texture of this product enhances my overall experience.	4.00
Q10	The texture of this product is better compared to similar products.	3.98

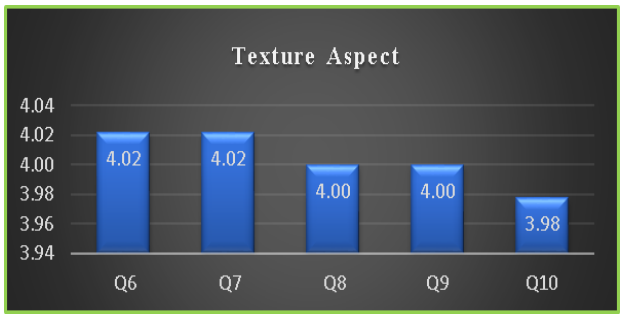

Fig. 5 - Texture aspect.

4.3.3 Color Aspect

The overall mean values for the color aspect indicate high satisfaction among respondents with the color of the evaluated product. Questions Q11 and Q12, each with the highest mean value of 4.02, show that the color of the 4K Mokaya product is considered attractive, appetizing, and consistent. Questions Q13 and Q14, with mean values of 4.00, indicate that respondents like the color of this product and feel it enhances its appeal. Although Question Q15 has a slightly lower mean value of 3.98, it still suggests that the color of this product is regarded as better compared to similar products as presented in Table 4. Overall, these high and consistent mean values reflect positive acceptance and satisfaction with the color of the product. The accompanying bar chart clearly illustrates the mean values for each question, reinforcing the interpretation that the product's color is well received by users as shown in Fig. 6.

Table 4 - Color aspect.

Number of questions	**Item**	**Mean**
Q11	The color of the 4K Mokaya product is attractive and appetizing.	4.02
Q12	This product has a consistent color.	4.02
Q13	I like the color of the 4K Mokaya product.	4.00

Q14	The color of this product enhances its attractiveness.	4.00
Q15	The color of this product is better compared to similar products.	3.98

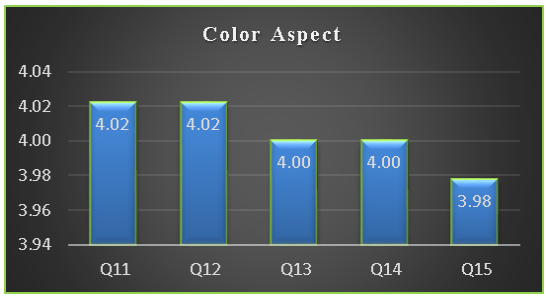

Fig. 6 - Age of respondents.

4.3.4 Overall Satisfaction Aspect

The mean values for the overall satisfaction aspect indicate that respondents are satisfied with the evaluated product. Questions Q16 and Q17, each with the highest mean value of 4.02, show that respondents believe the color of the 4K Mokaya product is attractive, appetizing, and consistent. Questions Q18 and Q19, with mean values of 4.00, indicate that respondents like the color of this product and feel it enhances the product's appeal. Although Question Q20 has a slightly lower mean value of 3.98, it still suggests that the color of this product is considered better compared to similar products as presented in Table 5. Overall, these high and consistent mean values reflect positive satisfaction and acceptance of the color of the product. The accompanying bar chart clearly illustrates the mean values for each question, reinforcing the interpretation that the product's color is well received by users as presented in Fig.7.

Table 5 - Overall satisfaction aspect.

Number of questions	Item	Mean
Q11	The color of the 4K Mokaya product is attractive and appetizing.	4.02
Q12	This product has a consistent color.	4.02
Q13	I like the color of the 4K Mokaya product.	4.00
Q14	The color of this product enhances its attractiveness.	4.00
Q15	The color of this product is better compared to similar products.	3.98

Fig. 7 - Overall Satisfaction aspect.

4.3.5 Recommendation Aspect

The mean values for the recommendation aspect indicate a high level of satisfaction and confidence among respondents regarding the evaluated product. Question Q21, with the highest mean value of 4.02, shows that respondents strongly agree with recommending this product to others. Questions Q22 and Q23, each with a mean value of 4.00, suggest that respondents believe the product is worth trying and would speak positively about it to their friends. Question Q24, with a mean value of 3.98, indicates that respondents are confident that the product deserves recommendation. Although Question Q25 has a slightly lower mean value of 3.98, it still reflects that respondents feel confident recommending the product to others as presented in Table 6. Overall, these high and consistent mean values reflect positive satisfaction and acceptance of the product. The accompanying bar chart clearly illustrates the mean values for each question, reinforcing the interpretation that the product is well received and trusted by users as shown in Fig. 8.

Table 6 - Recommendation aspect.

Number of questions	Item	Mean

Q21	I would recommend this product to others.	4.02
Q22	I believe this product should be tried by others.	4.02
Q23	I will speak highly of this product to my friends.	4.00
Q24	This product deserves my recommendation.	4.00
Q25	I feel confident recommending this product to others.	3.98

Fig. 8 - Recommendation aspect.

4.4 Discussion

The findings of this study indicate that Mokaya, which is based on Moringa and Seri Kaya, has successfully achieved the research objective of producing a vegetarian-friendly spread that is rich in nutrients. The use of Moringa leaves and fruit as key ingredients in Mokaya has proven to enhance the nutritional content of this product. This aligns with previous studies which state that Moringa is a complete protein source and is rich in essential vitamins and minerals (Leone et al., 2016; Gopalakrishnan et al., 2016). Mokaya contains nine essential amino acids, making it an excellent protein source for vegetarians who often face challenges in obtaining complete proteins from plant-based diets (Leone et al., 2016). Additionally, the presence of vitamins A, C, and E, as well as minerals such as calcium, potassium, and iron in Moringa, contributes to the increased nutritional value of Mokaya (Gopalakrishnan et al., 2016).

Antioxidants such as flavonoids, polyphenols, and ascorbic acid in Mokaya play a crucial role in protecting the body from oxidative damage and reducing the risk of chronic diseases, as reported by Saini et al. (2016). Bioactive components in Moringa, such as isothiocyanates, also provide anti-inflammatory effects that may help reduce inflammation and the risk of chronic conditions such as arthritis and heart disease (Stohs & Hartman, 2015). Sensory evaluation of Mokaya indicates a good acceptance in terms of taste, texture, and overall satisfaction (Miller, 2020). This is important because a major challenge in developing new food products is ensuring positive consumer acceptance. These results support the findings of Asgar et al. (2018), which emphasize the importance of innovation in vegetarian food products to meet dietary needs and consumer satisfaction.

Innovation in vegetarian food products continues to evolve with a focus on enhancing nutritional value and flavor to meet the growing demand for plant-based diets (Tachie et al., 2023). Plant-based meat alternatives, such as vegetable burgers and sausages, are becoming increasingly popular as they provide protein-rich options that are lower in saturated fats, making them a healthy choice for vegetarians (Sha et al., 2020). Additionally, plant-based dairy alternatives like almond milk, soy milk, and oat milk are also gaining widespread acceptance, offering lactose-free options that are rich in calcium and vitamin D, which are essential for bone health (Sousa et al., 2020). Innovations in vegetarian spreads and sauces, including nut butters, hummus, and now Mokaya, which is based on Moringa, provide tasty and nutrient-dense alternatives to conventional products that use animal-based ingredients (Asgar et al., 2018). This study demonstrates that incorporating Moringa into vegetarian food products not only enhances their nutritional value but also provides a delicious and appealing alternative to traditional spreads that typically contain animal-based ingredients. This aligns with the global trend toward plant-based diets and the growing demand for vegetarian-friendly food products (Sha et al., 2020). The use of Moringa in spreads such as Seri Kaya ensures that the product is not only nutrient-rich but also appealing in terms of taste and texture. Moringa-based food products can improve nutritional value without compromising on flavor, and they help address micronutrient deficiencies among vegetarians, making them a key component in food innovation (Leone et al., 2016; Gopalakrishnan et al., 2016).

Overall, this study successfully achieved its objective by developing Mokaya, a nutrient-dense vegetarian-friendly spread. The use of Moringa in Mokaya has enhanced its nutritional value and user acceptance, in line with existing literature findings. This study contributes to improving the health and well-being of vegetarians and opens up opportunities for further innovation in the plant-based food industry.

5. Conclusions

In conclusion, this study successfully demonstrates that the Mokaya food product, which combines the benefits of Moringa with Seri Kaya, has met the expectations outlined in the "Introduction" chapter. The results show that Mokaya is well-received by respondents in terms of taste, texture, color, and overall satisfaction. The high and consistent mean values for each assessed aspect reinforce the positive acceptance of this product among vegetarian consumers. This aligns

with the study's objective of creating a vegetarian-friendly food product that is not only delicious but also nutritionally dense. The prospects of this study indicate the potential for expanding Mokaya in the growing vegetarian food industry. Further research could focus on improving the product formulation and exploring the use of Moringa in various other food products to support a healthy lifestyle and balanced nutrition. This not only opens new opportunities in food innovation but also helps address the nutritional deficiencies often faced by vegetarians.

To ensure that Mokaya remains relevant and appealing to consumers, improving the product formulation is crucial. Further research could explore the use of different plant-based ingredients that could enhance the product's nutritional value and flavor. Additionally, broader market testing among various demographic groups of vegetarian consumers could provide more comprehensive feedback and help understand specific needs regarding taste, texture, and product acceptance. The application of advanced food processing technologies, such as freeze-drying or modified atmosphere packaging, could be implemented to extend the product's shelf life without compromising taste and nutritional quality. Developing Mokaya variations with different flavors, such as chocolate, vanilla, or tropical fruits, could attract diverse consumer interests.

Awareness and education campaigns about the health benefits of Moringa and Mokaya products need to be conducted to enhance understanding and acceptance among consumers. Long-term studies to assess the nutritional impact of Mokaya on consumer health could also be carried out to demonstrate the health benefits associated with the product and improve its credibility in the market. Cost optimization in production should be explored to reduce expenses without compromising product quality. This includes finding more cost-effective sources for raw materials or improving production efficiency. With these recommendations and improvements, Mokaya has the potential to become a more accepted and successful product in the market, meeting the nutritional needs of vegetarians and contributing to a healthier lifestyle.

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Conflict of Interest

The authors declare no conflicts of interest.

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