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Production of Moringa based Food Flavouring with the Addition of Dried Shrimp

Sebastianus Charmie Wadjong
Institut Pertanian STIPER
INDONESIA

Mohammad Prasanto Bimantio*
Institut Pertanian STIPER
INDONESIA

Maria Ulfah
Institut Pertanian STIPER
INDONESIA

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Abstract

Background: Moringa leaves, rich in essential nutrients like calcium, protein, and antioxidants, are widely valued for their health benefits. However, due to their natural bitterness and strong aroma, they are commonly consumed as capsules or teas rather than incorporated into everyday meals, limiting their market reach.
Aim: To increase consumer acceptance, especially among children and adults seeking nutritious foods, "Bon Kelor" was developed as a moringa-based food flavouring with added dried shrimp to enhance both flavour and nutritional value. This study aimed to evaluate the effects of blanching time and dried shrimp addition on the nutritional and sensory qualities of "Bon Kelor" and to determine the most favourable formulation.
Methods: The research used a Complete Block Design with two factors: blanching time (1, 3, and 5 minutes) and dried shrimp concentration (5%, 10%, and 15%). The products were assessed for yield, moisture, ash, fibre, protein, calcium, and organoleptic characteristics such as aroma, colour, and taste.
Result: Blanching time significantly affected water, ash, and fibre content, as well as taste, while dried shrimp addition notably increased ash, fibre, protein, and calcium levels. The optimal formulation, based on overall liking among panellists, featured a blanching time of 5 minutes and a dried shrimp concentration of 15%, yielding a balanced nutritional profile and improved taste.
Conclusion: This formulation had a moisture 5.85%, ash 16.64%, fibre 14.04%, protein 21.89%, and calcium 74.41 ppm.

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INTRODUCTION

Moringa leaves, known for their dense nutritional profile, contain vital nutrients including calcium, protein, antioxidants, and essential amino acids, making them an attractive component for health-focused food products. Given the rich nutritional profile of moringa leaves and the various advancements in food processing technology in the modern era, the utilization of moringa extends beyond mere consumption as a vegetable. It is now incorporated into a wide range of processed forms, including puddings, cakes, fortified products (various foods, beverages, and snacks), pharmaceutical products such as capsules, tablets, and oil, and can also be dried and processed into flour, extracts, or other forms. In the realm of health, aside from its applications as an herbal ingredient, moringa leaves are commonly used to make tea (Marhaeni, 2021). However, the bitterness and distinct aroma of moringa, due to compounds like saponins and tannins, present significant challenges for consumer acceptance in everyday diets. Saponins contribute to the bitterness and create a foamy texture, which can adversely affect consumer acceptance of processed products fortified with moringa leaf extract.

While moringa is often consumed as capsules or teas, these forms limit its accessibility and appeal for wider audiences, particularly children and health-conscious adults. Thus, before processing, blanching is necessary, which involves subjecting the leaves to a specific temperature and time to preserve colour, deactivate enzymes responsible for colour and odour changes, and enhance nutritional quality (Medho & Muhamad, 2019). While most green leafy vegetables are low in calories and beneficial for managing obesity, moringa leaves stand out not only for their low-

* **Corresponding author:**
Mohammad Prasanto Bimantio, Institut Pertanian STIPER, INDONESIA. ✉bimantiomp@instiperjogja.ac.id

calorie content but also for their unique composition of essential nutrients that may offer specific benefits in obesity management (Ali Redha et al., 2021; Metwally et al., 2017). These leaves boast a protein content of approximately 19-20% and contain around 16-24% dietary fibre relative to their total weight. Additionally, moringa leaves are rich in antioxidants, with higher antioxidant levels than many fruits, including strawberries. They have been established as sources of folic acid and unsaturated fatty acids, rendering them potential supplements for addressing malnutrition (Rani et al., 2019). The substantial antioxidant profile of *Moringa oleifera* leaves is well-documented; research by Folorunso et al. (2012) and Busani et al. (2011) highlights significant concentrations of beta-carotene (174 mg/kg), vitamin C (7,231 mg/kg), and vitamin E (1,100 mg/kg). Further supporting these findings, Razis et al. (2014) synthesized the plant's broader therapeutic value, underscore both its nutritional density and its potent antimicrobial and antioxidant functionalities.

In several developing countries, moringa leaves have been widely employed in food fortification initiatives. The purpose of fortifying foods with moringa leaf powder is to meet the nutritional requirements of the population. Moringa leaves contain 40% protein, 44% amino acids, and provide 100 mg of calcium. Moringa leaf powder has significantly higher calcium content than fresh moringa leaves, exceeding 400 mg per serving. Additionally, moringa leaf powder can serve as a substitute for iron tablets in the treatment of anemia (Shija et al., 2019). Moringa leaves also exhibit higher iron content than spinach (Rani et al., 2019). In one research effort, Indriasari et al. (2019) created moringa biscuits, where moringa leaves were transformed into flour and used to enrich the nutritional content of biscuits. Another study by Kusuma et al. (2017) explored the creation of moringa nori, utilizing moringa leaves for a unique culinary application. Moringa leaves have also found use as an additional ingredient in making alkaline noodles, as evidenced in research conducted by Khasanah and Astuti (2019).

Blanching is a culinary technique involving the immersion of food items, typically vegetables and fruits, into boiling water within the temperature range of 75-95 °C for a short duration of 1-10 minutes. Subsequently, the food items are rapidly transferred to ice or cold water to halt the cooking process and residual heat in the food post-boiling (Rachmawati et al., 2021). Blanching serves to inactivate enzymes responsible for the bitter aroma in moringa leaves and minimize colour changes in the leaves. Since the bitter aroma and colour of moringa leaves can significantly influence consumer preference, colour, and taste evaluations (Abrianti, 2018). Although fresh *Moringa* leaves consist of nearly 75% water (Ali et al., 2017), their nutritional value can be maintained through low-temperature oven drying to minimize quality degradation. Additionally, incorporating a blanching step has been demonstrated by Yang et al. (2006) to enhance both antioxidant levels and iron availability within the leaf matrix.

Dried shrimp, a product derived from fresh shrimp that is processed into dried shrimp, is often further utilized as a cooking seasoning to impart a shrimp aroma and enhance the flavour of dishes. Dried shrimp serves as a substitute for fresh shrimp, as dried shrimp contains a substantial protein content of 62 g per 100 grams of the ingredient (Yasmin & Lastariwati, 2020). Dried shrimp has also found applications as an additive in various products, such as nuggets (Rahayu et al., 2019). Additionally, research by Purba et al. (2020) has shown how shrimp can be used to fortify hydrolysed protein in sago noodles. The incorporation of dried shrimp into "Bon Kelor" is expected to mitigate the undesirable taste and bitter aroma associated with moringa leaves. These findings collectively demonstrate the versatility of moringa leaves and the diverse applications of dried shrimp in food processing, contributing to the enhancement of nutritional quality, flavour, and culinary experiences.

The term "Bon" in "Bon Kelor" is inspired by a popular brand, "Bon Cabe," which is a blend of "*Abon*" (shredded meat) and "*Cabe*" (chili). *Abon* is typically made from various meats, including beef, buffalo, chicken, goat, lamb, and fish, but there have also been innovations using vegetables, including chili. In general, the production of "Bon" typically involves several stages, as indicated by research conducted by Reringga et al. (2019). This process includes ingredient preparation, blanching, crushing, and concluding with the drying phase. "Bon Kelor" aims to make moringa more appealing and versatile in daily meals, expanding beyond traditional herbal applications. This approach aligns with consumer trends favoring functional foods that combine health benefits with palatable flavors, addressing a gap in the market for nutritious, accessible food products.

This study addresses these limitations by developing "Bon Kelor," a moringa-based food flavouring enriched with dried shrimp.

The addition of dried shrimp not only enhances the nutritional content, boosting protein and calcium levels but also serves to improve the flavour profile by masking moringa's bitterness and enhancing its savoury qualities.

By transforming moringa into a functional food product that combines both nutritional and sensory appeal, this research introduces a novel approach that expands moringa's applications within the consumer market. Additionally, this study applies the Complete Block Design to systematically evaluate the optimal blanching time and dried shrimp concentration, providing insights into both nutritional and organoleptic improvemen

METHOD

Research Design

Sample Preparation

Fresh moringa leaves (Moringa oleifera) were sourced from Maguwoharjo, Sleman, Yogyakarta. For uniformity, only young and vibrant green leaves were selected. The leaves underwent thorough cleaning to remove dirt and any foreign particles prior to blanching. Dried shrimp, supplied and purchased in Sleman, Yogyakarta, were processed and dried following standard food-grade practices to ensure consistent flavor and nutritional quality. Additional seasoning ingredients, including onion, garlic, chili, sugar, salt, and flavoring, were all procured from Yogyakarta.

The study utilized various equipment and tools to ensure precise measurements and uniform processing. An analytical scale by Ohaus, located at Instiper Yogyakarta, with an accuracy of ±0.001 g, was used for all measurements. A Tyler mesh sifter with a mesh size of -30+40 from Instiper Yogyakarta facilitated uniform particle size distribution. Blending and drying processes were carried out using a blender and stove, also sourced from Instiper Yogyakarta. These tools and procedures ensured the consistency and reliability of the material preparation.

Experimental Design

The study employed a Complete Block Design with two factors: blanching time and dried shrimp concentration. Blanching was performed at three time intervals (T) (1, 3, and 5 minutes), while dried shrimp (E) was added at concentrations of 5%, 10%, and 15%. Each treatment combination was replicated twice, resulting in 18 experimental units. This design minimized the impact of extraneous variables, allowing for clearer assessment of the treatment effects.

Procedures

Production Process

The production process of "Bon Kelor" begins with the meticulous preparation of its key ingredients. For the moringa leaves, fresh ones with a deep green hue are carefully selected. These leaves are then separated from their stems, sorted, and thoroughly washed to eliminate any impurities. Following this, they undergo blanching at a consistent temperature of 80 °C for different durations, depending on the desired outcome. After blanching, the leaves are drained and sun-dried until they achieve a crushable texture. Subsequently, they are sifted to ensure uniformity.

Simultaneously, the dried shrimp undergoes its own processing. The shrimp are roasted until they attain a reddish colour, then coarsely blended and sifted to achieve the desired particle size. In tandem with these steps, seasoning ingredients including garlic, shallots, and chili powder are prepared. The garlic and shallots are fried until crispy and dry, then blended and sifted to form a spice blend along with chili powder, black pepper, salt, and seasoning.

Finally, the assembly of "Bon Kelor" commences. The dried moringa leaves, seasoning ingredients, and dried shrimp are combined in appropriate proportions, thoroughly mixed, and roasted for a specified duration. The resulting product is allowed to cool before being packaged and subjected to analysis. This meticulous process ensures the consistent quality and flavour of "Bon Kelor", a product crafted with care and precision.

This comprehensive process outlines the steps involved in preparing "Bon Kelor," a flavourful and nutritious product combining moringa leaves, dried shrimp, and a blend of seasoning ingredients.

Analysis plan

Product Analysis

Analysis of the product is carried out for chemical analysis consisting of yield tests, water content, ash content, fibre content, protein content, and calcium levels.

The yield of moringa leaves is calculated as the ratio of the weight of dried moringa leaves obtained after drying to the initial weight of the fresh leaves before drying, expressed as a percentage.

Water content was determined using the oven-drying method. Approximately 2 g of the sample was placed in a pre-weighed crucible and dried in an oven at 105 °C until a constant weight was achieved. Water content was calculated as the percentage weight loss during drying (Kusuma et al., 2020).

Ash content was measured by incinerating approximately 2 g of the sample in a muffle furnace at 550 °C for 4 hours. The residue remaining after combustion was weighed, and ash content was expressed as a percentage of the initial sample weight (Wickramasinghe et al., 2020).

Crude fiber was determined using the acid-base digestion method. The sample was sequentially digested with 1.25% sulfuric acid and 1.25% sodium hydroxide solutions. The residue was filtered, dried, and weighed before incineration. The weight difference before and after ashing was recorded as crude fiber content (Wickramasinghe et al., 2020).

Protein content was analysed using the Kjeldahl method. The sample was digested with concentrated sulfuric acid in the presence of a catalyst to convert organic nitrogen to ammonium sulfate. The digested solution was distilled, and the ammonia released was titrated with a standard acid solution. Protein content was calculated using a nitrogen-to-protein conversion factor of 6.25(Nobosse et al., 2017).

Calcium levels were determined using Atomic Absorption Spectrophotometry (AAS) Shimadzu AA-7800F. The sample was digested in a mixture of nitric acid and perchloric acid, filtered, and diluted to a suitable volume. The absorbance of the solution was measured at the calcium-specific wavelength, and the concentration was calculated using a standard calibration curve (Wickramasinghe et al., 2020).

Organoleptic Testing

Twenty sensory panel evaluated the product for aroma, colour, and taste using a structured scoring system from 1 to 7. The organoleptic tests aimed to assess consumer preferences and overall acceptability of "Bon Kelor." The sensory attributes were scored based on a predefined scale, and feedback from the panel provided valuable insights into the product's sensory characteristics.

Data Analysis

The effects of blanching time and dried shrimp concentration on the measured attributes were statistically analysed using SPSS software version 29. A 5% significance level was employed for determining significant differences among treatments. Post hoc tests, such as Duncan Multiple Ranged Test, were conducted to further identify differences between specific treatment combinations.

RESULTS AND DISCUSSION

Results

Water Content

The analysis of the product's water content indicates that an extended blanching duration for moringa leaves leads to a proportional increase in the product's water content, and this relationship is statistically significant, as shown in figure 1. This observation aligns with research conducted by Kusuma et.al. (2020) which suggests that the increase in water content is due to the longer blanching time, causing the moringa leaves to absorb more water. The substantial water absorption by moringa leaves is attributed to their high fibre content.

Shown in figure 2, the addition of dried shrimp to "Bon Kelor" was found to have no statistically significant impact on the product's water content. However, upon closer examination, the water content tended to decrease with the addition of dried shrimp, consistent with the findings of a study by Purba et al. (2020). Their research indicates that higher concentrations of dried shrimp result in lower water content, as dried shrimp is a low-moisture ingredient. The lack of a significant effect in this study may be attributed to the relatively small amount of dried shrimp added and the absence of a comparison or control group, such as a 0% dried shrimp addition scenario.

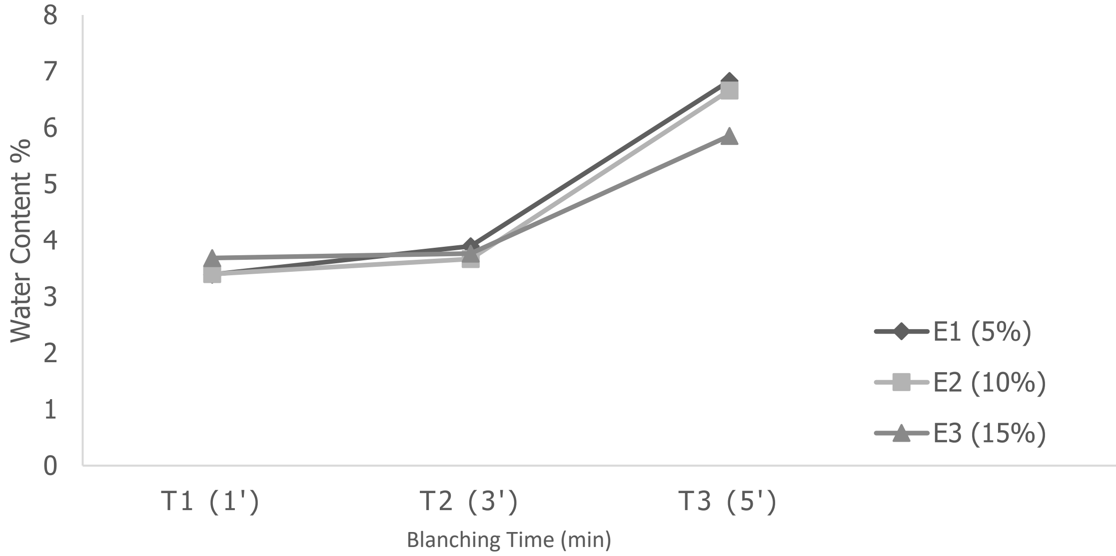

Figure 1. Product's water content along blanching time

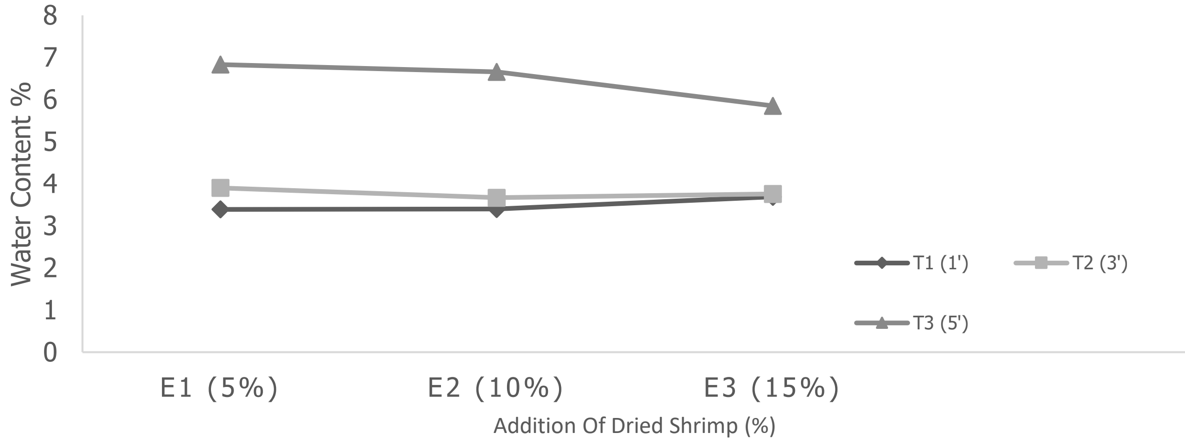

Figure 2. Product's water content along addition of dried shrimp

The water content obtained in this study already complies with the Indonesian national standard or SNI (Standard Nasional Indonesia) for dried seaweed. According to the standards set by the Badan Standarisasi Nasional in 2015, the acceptable range for water content in dried seaweed is 12.0% to 30.0%. In this research, the average water content was found to be less than 7%, demonstrating that it falls well within the prescribed range and meets the SNI requirements for dried seaweed.

Ash Content

As shown in figure 3, the analysis of the ash content of the product demonstrates that the duration of blanching significantly influences the product's ash content with negative correlation. This observation aligns with a study conducted by Wickramasinghe et.al. (2020) , which suggests that the reduction in ash content is due to the leaching of water-soluble minerals into the blanching water rather than evaporation. During blanching, minerals like potassium, calcium, and magnesium can dissolve into the water, especially with prolonged blanching times, leading to a decrease in the ash content of the leaves.

The addition of dried shrimp to the product was found to have a significant effect on the ash content and increase along addition of dried shrimp as shown in figure 4. This is consistent with research conducted by Wenno et.al. (2022), which states that the ash content and composition depend on the type of ingredient and the process. When ingredients are processed through drying, it tends to increase the ash content because the moisture in the ingredients has already evaporated. It's worth noting that the Indonesian national standard (SNI) specifies a maximum ash content of 14% for dried shrimp.

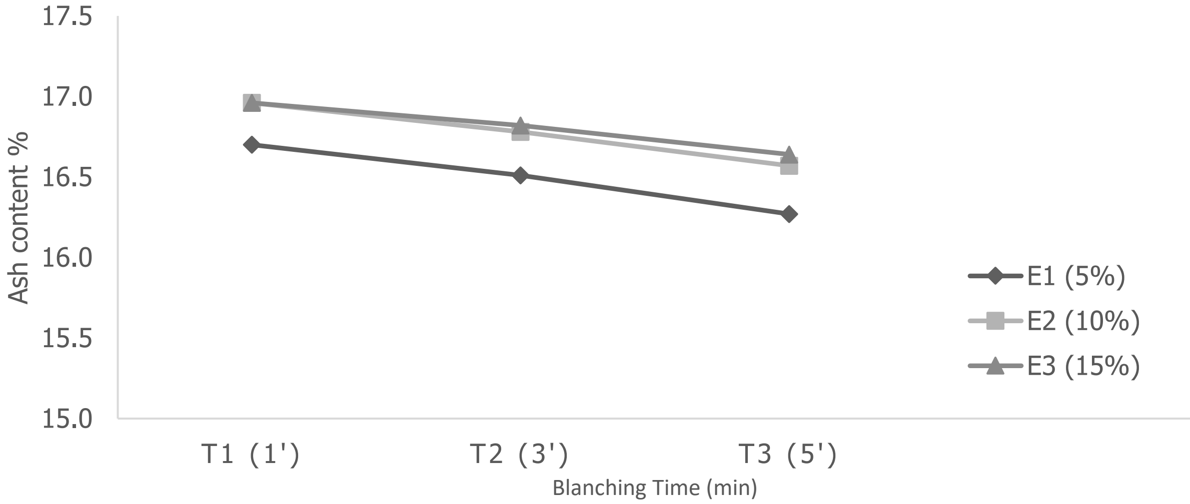

Figure 3. Product's ash content along blanching time

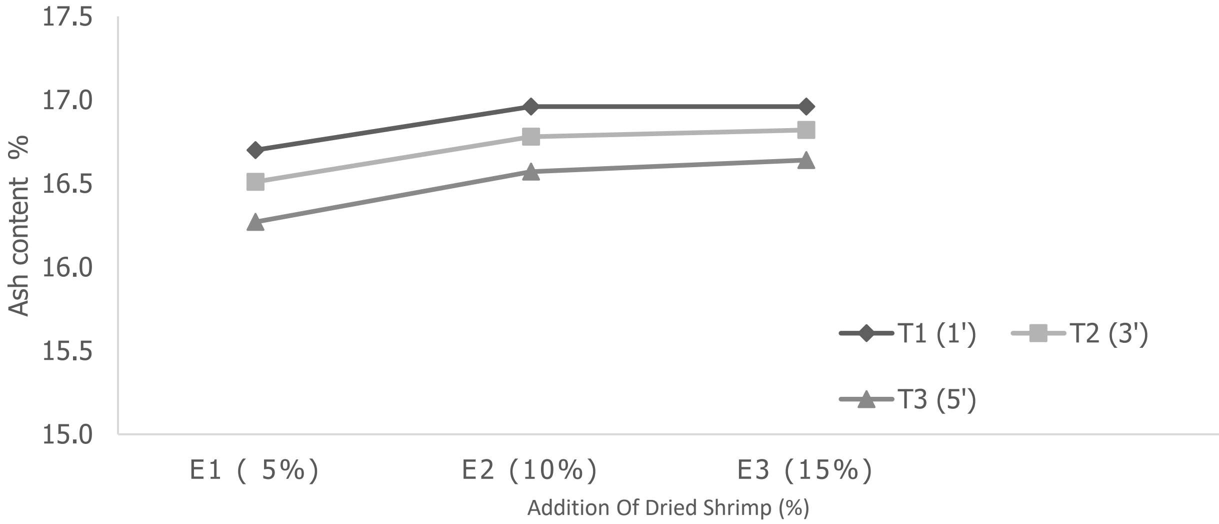

Figure 4. Product's ash content along addition of dried shrimp

Based on the research conducted by Valentine et.al. (2020), the ash content in the production of nori typically ranges from 11.14% to 14.71%. However, in the case of "Bon Kelor," the research findings indicate a higher ash content. The average ash content obtained in this study falls within the range of 16% to 17%. This suggests that "Bon Kelor" has a somewhat higher ash content compared to nori production, as per the cited research.

Fibre Content

Figure 5 shows that the average crude fiber content in 'Bon Kelor' increases with longer blanching durations, suggesting a significant effect of blanching on fiber levels. This result contrasts with findings by Wickramasinghe et.al. (2020), which indicate a reduction in fiber content due to blanching. Blanching could influence fiber content in several ways. Prolonged blanching often softens the plant tissue structure, potentially releasing bound fiber components and altering their measurement. However, with shorter blanching times, as used in 'Bon Kelor' production, fiber breakdown may be minimal, preserving the crude fiber content. Additionally, blanching can reduce soluble fiber by leaching certain fibers into the water. However, insoluble fiber, such as cellulose and lignin, may remain relatively intact, and their proportion could appear to increase if soluble components are leached out.

The addition of dried shrimp has a significant impact on the crude fiber content of "Bon Kelor, resulting in an increase in crude fibre content with each added quantity of dried shrimp as shown in figure 7. This observation is in line with the research conducted by Suripto et al. (2022) because dried shrimp itself contains approximately 0.67% crude fibre. Therefore, the more dried shrimp added, the higher the crude fibre content in "Bon Kelor."

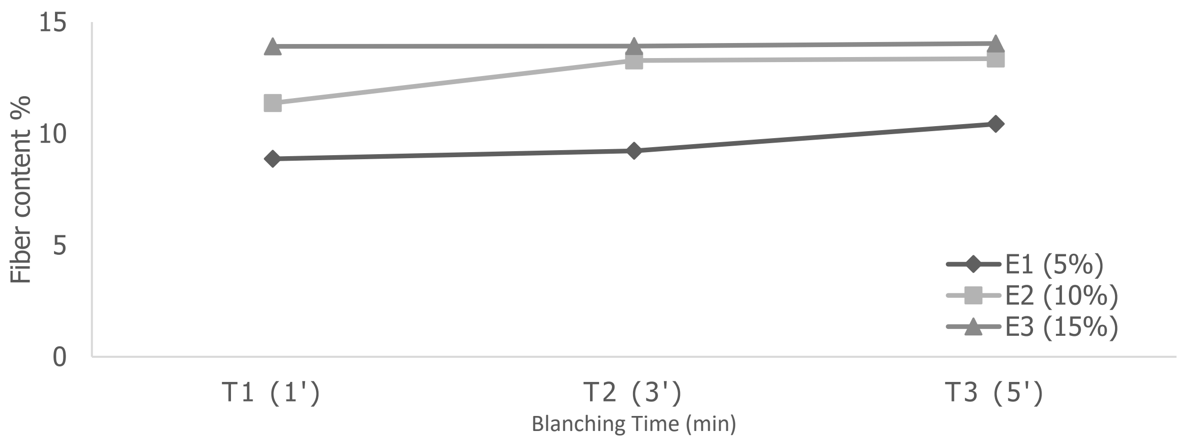

Figure 5. Product's fibre content along blanching time

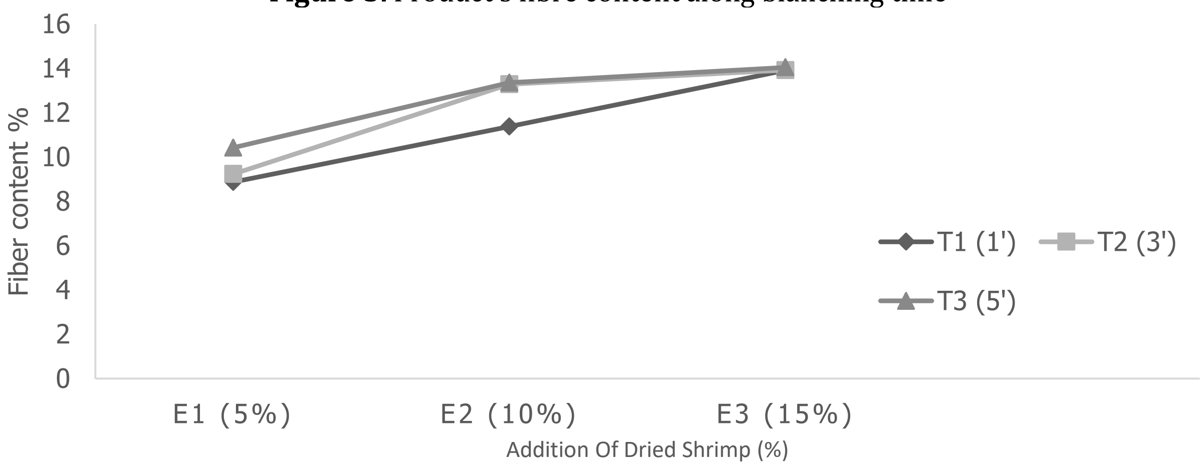

Figure 6. Product's fibre content along addition of dried shrimp

Protein Content

The protein content analysis of the product as shown in figure 7, confirm that the blanching duration does not have a significant impact on the protein content of "Bon Kelor." This finding contradicts the research conducted by Nobosse et.al. (2017), which suggests that longer blanching times can reduce protein content. This discrepancy can be attributed to the relatively short blanching time used in this research, meaning that the blanching time employed in this study is sufficient to preserve the protein content.

On the other hand, the addition of dried shrimp as shown in figure 8 results in a significant influence on protein content, and there is an increase in protein content with each addition of dried shrimp. This is because dried shrimp has a high protein content. This observation aligns with the research conducted by Suripto et al. (2022), which states that the protein content of raw dried shrimp is approximately 25.82%. Therefore, the higher the concentration of added dried shrimp, the higher the protein content in "Bon Kelor." Compared to nori, as researched by Valentine et.al. (2020) with a protein content ranging from 11.34% to 12.89%, "Bon Kelor" in this study has a higher protein content, averaging between 19% to 21%.

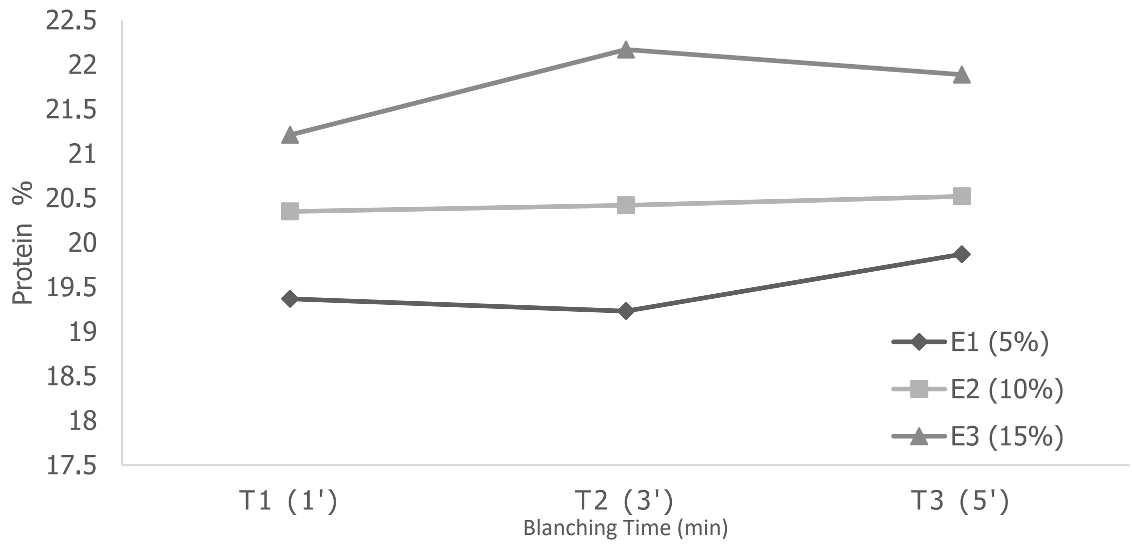

Figure 7. Product's protein content along blanching time

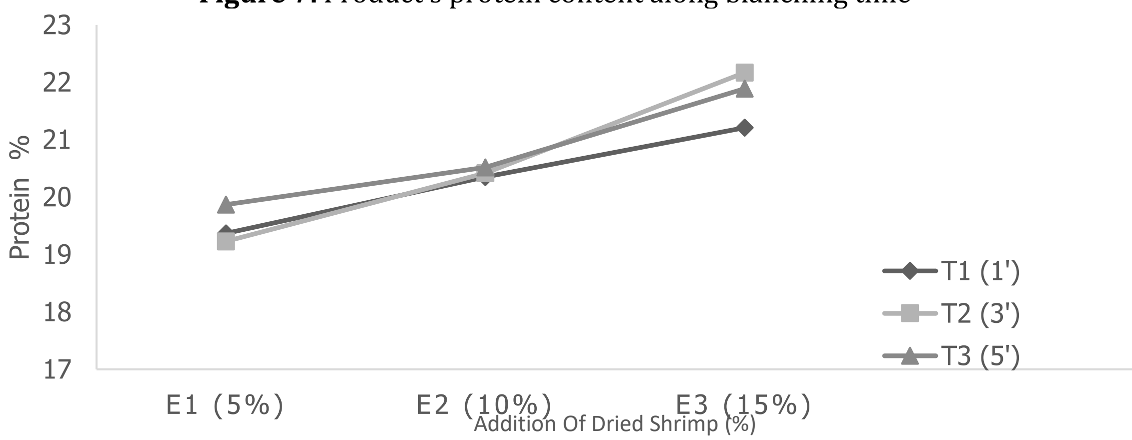

Figure 8. Product's protein content along addition of dried shrimp

Calcium Content

The calcium content analysis reveals that blanching duration does not significantly reduce calcium levels in 'Bon Kelor,' although a slight increase in calcium content is observed with longer blanching times (Figure 9). In general, prolonged blanching can lead to a reduction in calcium content because water-soluble minerals, including some forms of calcium, can leach into the blanching water. This effect is typically more pronounced with extended blanching times and higher temperatures, as seen in studies like Wickramasinghe et.al. (2020), which suggests that blanching can reduce calcium content. This discrepancy is likely due to the relatively short blanching time used in this study, indicating that the blanching time employed is still safe for preserving the calcium content in moringa leaves. However, the short blanching times used in 'Bon Kelor' production likely minimized mineral loss, effectively preserving calcium content in the moringa leaves. The observed increase in calcium content with longer blanching times may also result from the combined calcium contribution of added ingredients, such as dried shrimp, which is naturally high in calcium, as well as other additives like shallots and garlic. These ingredients could contribute additional calcium to the final product, leading to a higher overall calcium content in the analyzed samples. Thus, the observed variation in calcium levels is likely due to the additive effects of these ingredients rather than a direct effect of blanching duration alone."

On the other hand, as shown in figure 10 the addition of dried shrimp has a significant impact on the calcium content of "Bon Kelor," resulting in an increase in calcium content with each addition of dried shrimp. This aligns with the research conducted by Anwar (2018), which states that 100 g of shrimp contains 2306 mg of calcium. Therefore, the higher the concentration of added dried shrimp, the greater the calcium content in "Bon Kelor."

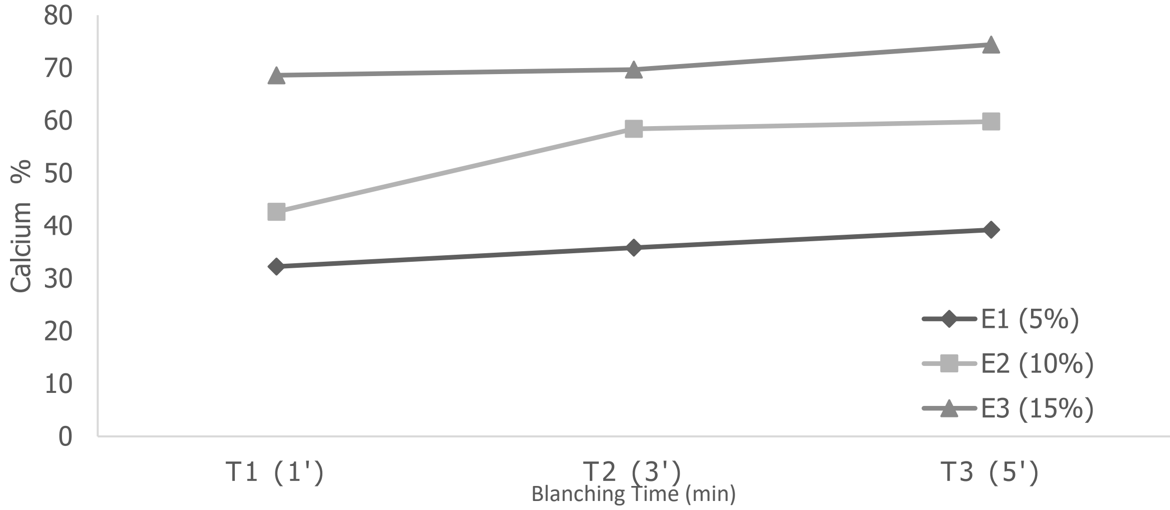

Figure 9. Product's calcium content along blanching time

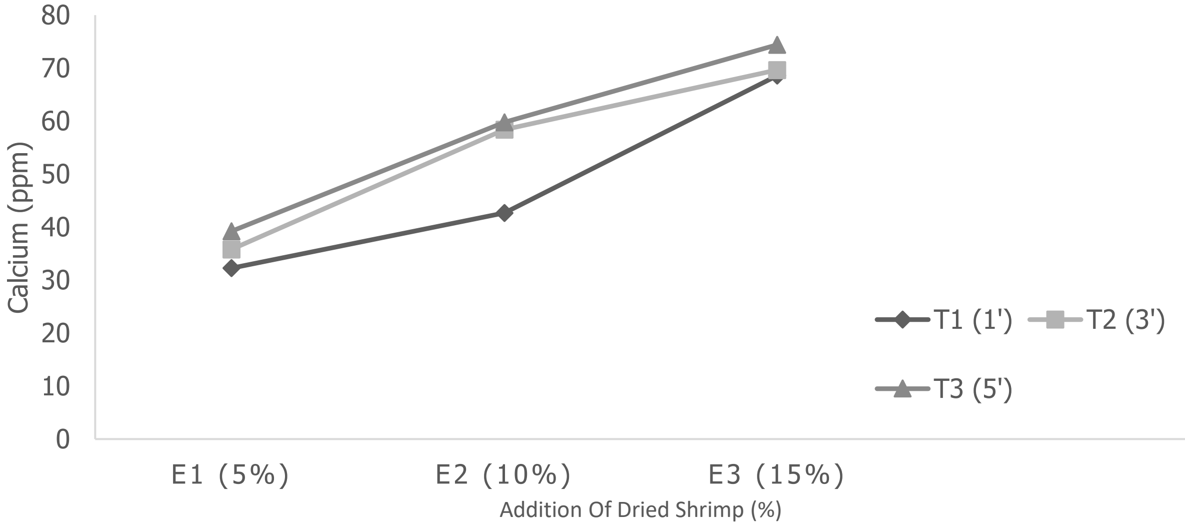

Figure 10. Product's calcium content along addition of dried shrimp

Yield

The yield of dried moringa leaves increased with longer blanching times, resulting in T1 = 15.69%, T2 = 15.84%, and T3 = 17.19%. However, based on the statistical analysis, these results were found to be not significantly different, and there were no significant differences between the treatments. This aligns with the findings of Setyowatik et.al. (2017), who observed that yield in dried moringa is influenced not only by blanching time but also by factors such as temperature and drying duration.

In this study, the blanching times used were relatively short, likely insufficient to significantly affect the structural integrity of the leaves, which can influence the extent of moisture retention or loss during subsequent drying. The drying process itself has a greater effect on final yield, as it removes most of the remaining moisture, thereby overriding any minor moisture loss differences resulting from blanching. Furthermore, blanching could cause minimal leaching of water-soluble compounds, such as certain minerals and phytochemicals, into the blanching water, but this effect is limited and might not considerably impact the total dry matter yield. This suggests that in 'Bon Kelor' production, blanching time alone does not notably affect the yield, reinforcing that temperature and drying time play more significant roles in determining the final yield of dried moringa leaves.

Organoleptic Test and Best Formulation

The average scores from the organoleptic taste test for all samples indicate that there is no significant difference in the preference level for the product among all the panellists. This is because the majority of the panellists gave similar ratings, which is "moderately like." This is likely due to the overall similarity in aroma, colour, and taste among the samples tested. The organoleptic test results in Table 1 show that both blanching time and the addition of dried shrimp resulted in a "moderately like" category, with sample code T3E3 having the highest average score of 5.60. This sample, with a blanching time of 5 minutes and the addition of 15% dried shrimp, is the most preferred formulation according to the panellists.

Table 1. Organoleptic Test Result

Sample	Aroma	Colour	Taste	Average	Notes
T1E1	5.20	5.53	5.53	5.49	moderately like
T1E2	5.43	5.40	5.40	5.45	moderately like
T1E3	5.50	5.33	5.33	5.41	moderately like
T2E1	5.25	5.20	5.20	5.42	moderately like
T2E2	5.15	5.45	5.45	5.41	moderately like
T2E3	5.18	5.45	5.45	5.42	moderately like
T3E1	5.08	5.33	5.33	5.42	moderately like
T3E2	5.33	5.25	5.25	5.40	moderately like
T3E3	5.18	5.85	5.85	5.60	moderately like

Based on Table 2, assessments were made for chemical analysis results on a scale ranging from 1 to 10. The analysis results for "Bon Kelor" products were compared with the values of SNI for dried seaweed and previous research on nori or similar products. The highest score was given to the sample that closely matched the reference values. For organoleptic evaluation, assessments were made on a scale of 1 to 5 based on the results in Table 1.

Based on the assessments, the highest scores for both chemical analysis and organoleptic evaluation were obtained for the sample with code T3E3, which received a total of 53 points. This was followed by the samples with codes T1E1 and T3E2, which ranked second and third, respectively. Sample code T3E3 corresponds to a blanching time of 5 minutes and the addition of 15% dried shrimp.

Table 2. Assessment to Calculate Best Formulation

Sample	Water	Ash	Fibre	Protein	Calcium	Aroma	Colour	Taste	Yield	Total
T1E1	9	5	10	7	6	2	4	3	3	49
T1E2	10	3	7	8	8	4	3	1	4	48
T1E3	8	3	6	9	9	5	2	1	5	48
T2E1	6	7	6	8	6	2	1	4	3	43
T2E2	9	5	7	9	8	1	3	2	4	48
T2E3	5	4	6	10	9	1	3	2	5	45
T3E1	4	10	8	8	6	5	2	3	3	50
T3E2	8	7	6	9	8	3	1	4	4	48
T3E3	7	6	5	9	10	1	5	5	5	53

Discussion

The differences in fiber and protein content observed in this study, compared to prior research, are likely due to distinct blanching processes. In contrast to previous studies, which may have employed higher blanching temperatures or longer durations, our approach prioritized a controlled temperature and variable time intervals (1, 3, and 5 minutes). This method aims to balance bitterness reduction and nutrient preservation, where shorter blanching may retain more nutrients but could fail to achieve the desired organoleptic qualities. Additionally, varying concentrations of dried shrimp could have contributed to the observed nutrient profile by interacting with moringa's inherent proteins and fibres, forming complexes that influence retention during processing.

To further investigate the role of blanching time on fibre and protein retention, a regression analysis was considered but could be expanded in future work by introducing more incremental blanching intervals, such as 2-minute or 30-second intervals. Regression analysis on these intervals would enable a clearer visualization of nutrient degradation patterns over time, potentially identifying an optimal blanching duration for maximizing both fibre integrity and protein retention in moringa-based products. This analysis could elucidate specific blanching times that minimize nutrient loss while achieving acceptable sensory characteristics.

Implications

Our results suggest that additional control over drying temperature and other ingredient handling processes may help mitigate variability across batches. For example, while drying temperature was held constant at 80 °C, variations in ingredient composition or slight differences in drying time could influence nutrient retention and overall product consistency.

Research Contribution

This research successfully designs a new value-added food product category that transitions moringa from conventional, low-appeal pharmaceutical capsules or medicinal teas into a versatile, savory food flavoring. This study also contributes a novel solution by demonstrating that the addition of dried shrimp effectively masks these undesirable sensory notes through flavor synergy, imparting a highly acceptable, savory flavor profile favored by taste panelists.

It provides explicit empirical data showing that a 5-minute blanching time coupled with a 15% dried shrimp concentration serves as the optimal configuration (T_3E_3), yielding superior scores across chemical and organoleptic metrics.

Limitations

Despite these promising biological findings, a notable limitation observed during processing involves the challenges in maintaining batch consistency due to external parameters. While core processing temperatures may be held constant, minor variations in general ingredient composition or subtle fluctuations in drying times can significantly influence overall nutrient retention and compromise product uniformity. Consequently, implementing stricter processing constraints—such as rigid regulation of drying conditions and more tightly managed raw material handling—is essential to reduce this inherent batch variability and ensure standard quality.

Suggestions

Future studies should document precise drying conditions and establish standardized ingredient ratios and processing times to minimize variability, improving consistency with prior research and enhancing reproducibility.

CONCLUSION

This study demonstrated that blanching time and dried shrimp concentration significantly influence the nutritional and sensory qualities of "Bon Kelor," a moringa-based food seasoning. Blanching was found to make an impact to water content, which contributes to product stability, while also impacting ash and fibre content and enhancing taste. Dried shrimp addition notably increased ash, fibre, protein, and calcium levels, addressing both the nutritional and flavour enhancement objectives of this study. These findings confirm that a 5-minute blanching time combined with 15% dried shrimp yields a balanced formulation that meets consumer preferences for a savoury, nutrient-dense seasoning.

While "Bon Kelor" offers improved nutritional benefits over moringa leaves alone—achieving higher fiber, protein, and calcium content, with reduced moisture content—the product's alignment with national standards (e.g., SNI) that not yet available for nutrient values and shelf-life stability could be further investigated to optimize quality and market readiness.

To enhance the accessibility and versatility of "Bon Kelor," future research should explore suitable substitutes for dried shrimp, which may help reduce costs or avoid allergen-related concerns. Potential alternatives include plant-based proteins or other seafood options that mimic dried shrimp's savoury profile. Additionally, studies on packaging and shelf life are recommended, as improved packaging could prolong freshness and ensure nutrient stability, meeting consumer expectations for quality and safety in functional food products.

AUTHOR CONTRIBUTION STATEMENT

MP designed the study, conducted experimental trials, performed data analysis, and drafted the manuscript. MU supervised the research framework, revised the analytical methodologies, and edited the final draft. SC assisted with laboratory processing, sensory evaluation coordination, and reference formatting.

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