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Formulation and Analysis of Sibujing Condiment through Design Thinking: An Instructional Recipe Innovation for Home Economics

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Abstract

Home Economics education fosters sustainability by using local ingredients in food innovations. This study explores the development of a Sibujing-based condiment, a spice traditionally used in Palapa and widely cultivated in Mindanao, Philippines. Further it also aimed to enhance Sibujing condiment by evaluating its characteristics, quality, consumer acceptability, and satisfaction among fifty (50) end-users. A research and development (R&D) design using a mixed-method approach was employed, integrating qualitative and quantitative data. The design thinking process guided product innovation, ensuring responsiveness to consumer preferences. Sensory evaluation, hedonic scale, and customer satisfaction metrics assessed three formulations, the most preferred variant undergoing physicochemical and nutritional analysis. A comparison with commercially available condiment was also conducted. Results showed that the enhanced Sibujing condiment had a light orange appearance with red streaks, pleasant aroma, a slightly salty taste, and a coarse, oily texture. Physico-chemical analysis revealed 5.43 g ash content, 36.57 g moisture, 3.71 g protein, and 30.75 g fat. Nutritional analysis showed 385.75 kcal per serving, with 79 out of 80 respondents preferring it over a commercial brand. The research concludes that the *Sibujing-based* condiment is highly acceptable and demonstrates strong potential as an instructional recipe. Developed through the design thinking process, it exemplifies food innovation using local ingredients and can serve as a model for teaching food preservation technology in Home Economics education.

Keywords: Sibujing; Home Economics Education; Food Innovation; Instructional Recipe; Design Thinking

1. Introduction

Sibujing, locally known as sakurab, is a traditional spice integral to Maranao cuisine, predominantly cultivated in the Lanao provinces of Mindanao, Philippines. It serves as the primary ingredient in a palapa condiment, a ubiquitous Maranao condiment combining sakurab with chili peppers, turmeric, garlic, salt, ginger, and coconut flakes or milk, enhancing the flavor of various dishes (Dapanas & Duero, 2020). Beyond its culinary applications, Sibujing possesses medicinal properties, including antimicrobial and antioxidant activities, attributed to its phytochemical constituents (Anides et al., 2019). The Sibujing imparts a distinctive flavor and odor, with higher levels of methionine and propiin contributing to its unique characteristics (Dey & Khaled, 2015).

Condiments are compounds commonly added to foods in small quantities to enhance the flavor of the food while cooking or for consumption. They are used as table dips, sauces, or appetizers (Chavasit & Photi, 2018). In addition, because of individual differences in food taste, people create condiments using abundant spices in their area to satisfy their taste. According to Spence (2015), condiment variations are a natural result of cultural differences in taste or cuisines.

Despite its cultural significance, there is a scarcity of systematic research on developing condiments that synergize Sibujing with other locally abundant spices like garlic and chili, and notably, no existing studies have explored this type of food innovation for educational use as an instructional recipe. Incorporating food innovation into educational settings, specifically through teaching food preservation techniques, adds and offers valuable interdisciplinary learning opportunities. Food preservation is not only crucial for food security and sustainability but also fosters scientific inquiry, cultural appreciation, and hands-on skill development among students it also fosters deeper appreciation for traditional foods while imparting essential skills in their lives (Barret & Lloyd, 2018). Further, by incorporating food preservation specifically as an instructional material can give a simple and easy to understand (Beavers et. al., 2023). Furthermore, introducing and teaching the students to create condiments like Sibujing used as preserved ingredients can enhance engagement in science, nutrition, and heritage education, making the culinary arts a relevant and practical learning tool in both formal and informal settings (Scazzocchio et al., 2021).

This study aims to develop a novel condiment by integrating Sibujing, garlic, and chili to enrich Maranao culinary traditions and to provide instructional materials for teaching Home economics. Central to this research is its purpose as a food innovation designed explicitly for instructional use in education—serving as a model recipe to be integrated into the Home Economics curriculum following the approach of Design Thinking process as a guide. Design Thinking is a process that creatively offers analytical processes for experimentation. Model creation and prototyping, feedback gathering, redesigning, solving for human problems, and increasingly used for food innovation (Dunne & Martin, 2020) and a logic, principle, practices, philosophy, and mental model, Design thinking is also defined as multidimensional as it is composed of 5 phases namely empathize, define, ideate, prototype, and test (Nakata & Hwang, 2020).

Further, Sensory evaluation was conducted through the use of questionnaires to assess the condiment's attributes, including acceptability and consumer satisfaction. The formulation which has the highest acceptability rating had undergone a food analysis, this includes nutritional profiling and physicochemical testing. By utilizing locally sourced and culturally relevant ingredients, this initiative promotes innovation in food education and supports multiple Sustainable Development Goals (SDGs). These include sustainable resource management through the use of indigenous crops (Obisanya, 2021), energy efficiency via localized production (Malalis et al., 2024), quality education through the integration of research-based instructional materials (Zabala & Goles, 2021), and poverty reduction by developing marketable food products that can contribute to economic

upliftment (Khan & Sultana, 2020). This research significantly contributes to the home economics program, which addresses the supply-demand imbalance and fosters local food industry growth. The program stresses culinary innovation at the same time Instructional Recipe for education, food entrepreneurship, and sustainable resource utilization, aligning with its objective of integrating practical and innovative solutions. Ultimately, this endeavor seeks to preserve and promote the rich cultural heritage of Maranao cuisine while providing an additional instructional that promotes lifelong skills.

2. Materials and Methods

This study utilized research and development design with mixed method data analysis to ensure the effectiveness of developing a Sibujing condiment, highlighting that the product developed answers the end user's needs. The mixed method is a design that incorporates both the qualitative and quantitative methods of data collection. It expounds phenomena through data from basic to complex statistical tools (Creswell, 1999).

This study employs the design thinking process, which has five (5) phases: empathy, define, ideate, prototype, and test. The empathy phase involves an exploratory qualitative phase to gain in-depth insights into the cultural preferences and expectations of the Maranao community regarding Sibujing. In this phase, in-depth focus group discussions using an interview guide were conducted, which provided a communal platform for participants to share their insights, preferences, and potential challenges associated with Sibujing usage. The qualitative data collected was thematically analyzed and presented through an empathy map emphasizing what respondents say, think, feel, and do about Sibujing. The empathy map was a foundation for the subsequent phases, ensuring the development process is rooted in the identified authentic needs and cultural nuances. In the empathy stage using the empathy mas as a guide, an interview session was used to gather insight and data regarding what could be the product that would be created and that could help the community, with the data collected it was analyzed to define problem opportunities and design challenges in utilizing Sibujing, further, this stage is where the first initiation on what could be the product that will be made. In the define stage, it is where the problem opportunities and design challenges from the empathy stage where defined which led to the ideate phase, in which in this phase involves the conception of the utilization of Sibujing as a main ingredient for condiments along with garlic and chili. The ideate phase includes brainstorming among researchers for recipe formulation, consultation with home economics teachers on ingredient measurements and preparation, how it will be made, and background readings in relevant published journals. The next step involved the creation of the formulated recipe, which was the prototype phase. The research transitioned to a quantitative phase following qualitative exploration, incorporating experimental designs and statistical analysis. To make sure the product met the acceptable standard the first prototype undergoes a series of test and evaluation, which involves analysis of sensory attributes, hedonic scale and acceptability among semi-experts and end users. Since design thinking is a non-linear process, the first evaluated prototype was improved by creating three formulations with variations of Sibujing ingredient ratios following the same procedure in evaluating the first prototype.

The formulation of the Sibujing condiment involved systematic variations in ingredient ratios, with a sensory evaluation conducted through a structured questionnaire to quantitatively assess aroma, appearance, taste, and texture. Acceptability and consumer satisfaction of the most acceptable formulation were also conducted. The most acceptable formulation of the sibujing condiment was further evaluated compared with a commercially available chili-garlic condiment to further justify its acceptability among the end users. Laboratory tests quantitatively measure physicochemical analysis such as moisture, crude content, ash, total fat, and nutrition facts. This dual-phased approach

ensures a holistic understanding, combining qualitative richness with quantitative rigor to address the multifaceted objectives of the study, and this analysis all takes part of the test phase of the design thinking process. The design thinking process made it possible to develop a product based on community and end-users needs, with the result of this evaluation, this product recipe would be reliable to use as an instructional recipe in teaching home economics, specifically in food preservation.

3. Results and Discussion

The research result was based on the objectives in developing the Sibujing condiment following the research process.

3.1 Empathy Map

Ten (10) end users were interviewed using an interview guide and a content analysis of what the end users say, think, feel, and do about the utilization of Sibujing in a Maranao community. Results showed that the end users say that the Sibujing is a condiment that adds and enhances the flavor. In addition, they also added that it is also used in making soup dishes like beef curry. Overall, it is used as a food enhancer. As the food industry introduces different foods, the end users think Sibujing can be introduced to other consumers, especially those who are passionate about making and eating unique food; it could also be good for exporting since it can be a good ingredient for a condiment that could be brought anywhere. Further, the end user states that the Sibujing should look green, red, or orange to look naturally appetizing.

Furthermore, respondents think Sibujing can be a condiment that adds a strong flavor and aroma that can easily captivate people. In addition, end users feel that Sibujing is very relevant to their food culture since it has been used by the community, especially in making their delicacies, and is one of the best condiments in Maranao. They also added that they want to try a new Sibujing product or use it in another dish or recipe.

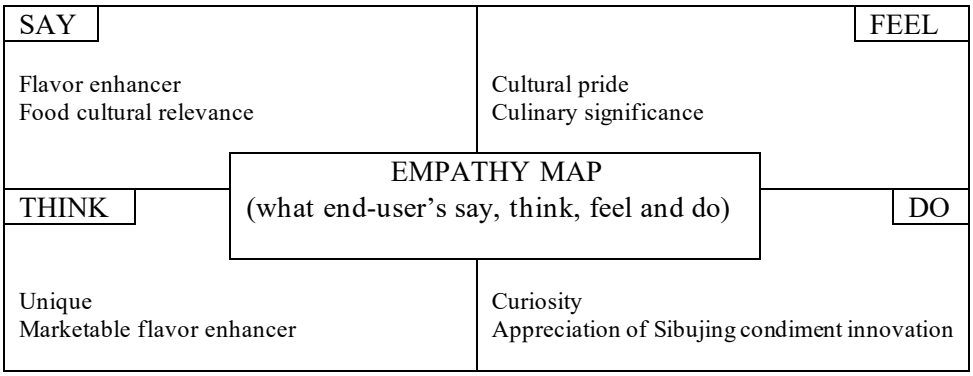

Figure 1. The Empathy Map

A design thinking process was integrated into the process of product development. Following the first stage of design thinking, which is the Empathy stage, the researchers conducted a community end-user interview using a structured interview guide to explore what they say, feel, think, and do regarding the utilization of Sibujing.

The result was analyzed using the Empathy map. The findings indicate that end users recognize Sibujing as a flavor enhancer and consider it culturally significant within their community. This result aligns with the research of Dapanas and Duero (2022), which highlighted that sibujing is a widely used ingredient in various Maranao dishes. These findings align with the present study, reinforcing that sibujing plays a dominant role in the culinary traditions of the local Maranao community to add flavor, aroma, and nutritional

value. In addition, respondents feel that the Sibujing is a source of cultural pride and culinary significance. This is consistent with research emphasizing the significance of the traditional ingredients in preserving cultural identity and enriching culinary heritage. A study by Macabalang-Mama and Cosrojas (2024) stated that sibujing is an invaluable ingredient in Maranao cuisine; this shows that sibujing is an integral part of every Maranao dish. Further, the respondents think sibujing has a distinctive ingredient which enhances flavor that maintains cultural authenticity.

Furthermore, respondents exhibit a keen curiosity and appreciation for the innovative sibujing condiment, reflecting a broader consumer trend towards exploring novel flavors and culinary experiences, likewise with the research by Abdullah & Putit (2023) reveals that consumer acceptance of innovative traditional food products is determined by factors such as perceived benefits, cultural relevance, and the balance between novelty and tradition. This implies that incorporating traditional ingredients into innovative products is efficient in satisfying consumer curiosity and promotes appreciation, thereby enhancing market acceptance.

3.2 Define Stage

The empathy map served as the basis for defining the problem opportunities and design challenges in the define stage, as shown in Table 1. Researchers have defined the problem opportunities: End users want to try other products made out of sibujing and preserve sibujing to make it continuously available. The design challenges include creating a new product made out of sibujing and preserving a product made of sibujing.

Table 1: Problem opportunities and design challenges

Problem Opportunities	Design Challenges
"End users want to try other product made out of sibujing."	"How might the researcher develop a new product made out of sibujing."
"Preserving sibujing to make it readily available all the time."	"How the researcher might preserve the product."

3.3 Ideate, prototype and testing stage

In the ideate stage, the researchers further consulted with community end-users to determine what products are available in the community that can be improved using Sibujing and how to preserve Sibujing-based products to make them readily available, specifically if it is seasonally unavailable. The researchers in the ideate stage identified the possibility of utilizing Sibujing as a condiment along with chili and garlic, with sibujing as the main ingredient. Results showed that problem opportunities were identified, including the need for new sibujing-based products and effective preservation methods to ensure its availability in the Maranao community year-round. The design challenges highlighted developing and preserving sibujing into an innovative food product. These insights led to the ideation process, resulting in the formulation of a sibujing condiment recipe, combining it with other ingredients to enhance its sensory appeal and acceptability. The development of the Sibujing condiment and other ingredients such as garlic and chili introduce a unique novel product that could appeal to traditional consumers and new markets. This aligns with the findings of Dapanas and Duero (2022), which highlight sibujing's widespread use in Maranao cuisine. This implies that the ideation of this innovation has the potential to position sibujing as a marketable flavor enhancer, offering both cultural significance and commercial viability in the food industry. This cultural significance is further supported by Aster et al. (2023) research on Philippine condiments, which recognizes their role in preserving culinary heritage and fostering cultural pride. The study signifies that sibujing can be developed into a condiment and can be an integral community identity. Thus, these studies highlight that respondents likely view the sibujing

condiment as a source of cultural pride and culinary significance, reflecting its integral role in their heritage and daily life. The ideation stage revealed the conceptualization of utilizing sibujing into a condiment along with other ingredients. A sibujing -condiment was then formulated as a prototype which undergoes test through a researcher made validated sensory attributes and consumer satisfaction questionnaire and the standard hedonic scale questionnaire for the over-all acceptability.

Table 2: Sensory Attribute of the first formulation of sibujing condiment

Sensory Attributes Indicator	Value	Description
Appearance	2.44 ± 0.88	Light orange with red streak
Aroma	2.67 ± 0.5	Very Pleasant
Taste	2.33 ± 0.74	Slightly salty
Texture	2.33 ± 0.87	Coarse and oily

Values represent mean ± standard deviation (n = 50)

The figure above presents the sensory attributes of the first formulation. The results indicate that, in terms of appearance, the product received a mean of 2.44 (SD = 0.88), described as light orange with red streaks; it has a red streak due to the natural color of the chili, which is mainly determined by the content of capsanthin and capsurbin (Tang et al., 2021). The aroma was rated highly, with a mean score of 2.67 (SD = 0.50), characterized as very pleasant. The high aroma rating indicates a strong consumer appeal, aligning with research emphasizing the importance of olfactory cues in food acceptance. The taste scored a mean of 2.33 (SD = 0.74), described as slightly salty, while the texture also received a mean of 2.33 (SD = 0.87), noted as coarse and oily. The developed sibujing condiment is oil-based; thus, its texture is due to the presence of oil in its formulation.

Design thinking is a nonlinear and iterative process (Malalis et al., 2024). This means that the comments given by the respondents were thematically analyzed to refine and improve the prototype. After testing and defining key feedback, the prototype was reformulated into three variations, each with varying amounts of Sibujing as the main ingredient. Table 3 presents the thematic analysis of respondents' comments, guiding the modifications to enhance the prototype.

Table 3: Respondents comments to improve the first formulation of sibujing condiment

Themes	Coded Response
Reducing the Oil	"The oil is too much that can contribute to the greasy feel inside the mouth." R1
Improve the Chili Texture	"Make the Chili same shape with the sibujing and garlic." R2 "The Chili cut is too big, improve its size or texture." R3 "The product sibujing Condiment is very acceptable but if it meant to be introduced to market, please use food processor to reduce the size of the granules of chili peppers." R4
Reducing the Garlic	"The Garlic overpowers the sibujing, the smell is overwhelming." R6

Out of fifty (50) respondents, only five (5) provided comments. Therefore, the thematic analysis was based solely on the responses from these five (5) participants, reflecting their insights and suggestions for improving the prototype. The table above shows the comments and suggestion of the respondents for the improvement of the formulations which includes reducing oil content, refining the chili texture, and achieving a balanced garlic flavor. Coded responses identified specific concerns, such as excessive oil contributing to an undesirable mouthfeel, the need for uniform chili particle size to ensure consistency with the Sibujing, and the overpowering garlic aroma, which masked the distinct scent of Sibujing.

Based on the respondents' or end-users' comments and suggestions, the researchers reformulated the Sibujing condiment and developed three formulations with varying amounts of Sibujing. The three formulations undergo the test stage, which includes sensory attributes, hedonic scale, and consumer satisfaction metric. Table 4 presents the Sensory attributes of the three formulations of sibujing condiment.

Table 4: Sensory attributes of the three formulations of sibujing condiment

Sensory attributes	F1		F2		F3	
	Mean	Description	Mean	Description	Mean	Description
Appearance	2.18	Yellow orange with red streak	2.18	Yellow orange with red streak	2.34	Light orange with red streak
Aroma	2.40	Moderately pleasant	2.36	Moderately pleasant	2.2	Moderately pleasant
Taste	2.28	Salty and very spicy	2.66	Slightly salty and very spicy	2.16	Slightly Salty and spicy
Texture	1.82	Coarse and oily	2.02	Coarse and oily	2.18	Coarse and oily

Values represent mean ± standard deviation (n = 50)
[1]F1 – sibujing condiment with 100g sibujing
[2]F2 – sibujing condiment with 75g sibujing
[3]F3 – sibujing condiment with 50g sibujing

The table above presents the sensory attributes of the three Sibujing condiment formulations, highlighting differences in their appearance. Among the three, Formulation 3 (F3) received the highest mean score of 2.34, described as light orange with red streaks. It shows that end users found this appearance the most appealing due to the common perception that orange is an appetizing and desirable food color. In the research of Fernández et al. (2014) it supports the idea demonstrating that variations in the orange hue of orange juice significantly impacted participants' sensory perceptions and overall liking. These findings imply that the orange coloration of certain foods can enhance their perceived flavor and attractiveness, ultimately influencing consumer preference. Regarding its aroma, formulation 2 (F2) received the highest mean score of 2.40 because of its well-balanced combination of ingredients, specifically sibujing and garlic. Since garlic is known for its strong and pungent aroma, which can easily overpower other flavors if not controlled. Adding sibujing has reduced the garlic's pungent aroma, creating a more pleasant and appealing scent. In the book of Lawless and Heymann (2010) explained that the aroma of food can significantly contributes to the consumer preferences. It also states that pleasant aromas stretch and enhance acceptability, on the other hand, overly dominant smells may reduce foods palatability. Thus, it highlights the necessity of a balanced aroma of ingredients to promote end-user satisfaction. This highlights the importance of ingredient synergy in developing innovative food products that appeal to sensory expectations. F2 got the highest mean score of 2.66 regarding its taste, described as slightly salty and very spicy. Due to the balanced proportion of sibujing with other ingredients, it resulted a well blend of saltiness and spiciness. Research indicates that the interaction between basic tastes and pungency can significantly influence flavor perception and consumer preferences. Likewise, with the research of Amyoony et al., 2023, where they noted that foods interacting with basic taste found that when combined with salty and spicy flavors can improve the overall taste which increases acceptability. This implies that achieving a well-balanced saltiness and spiciness is necessary to satisfy the consumer's preferences. Furthermore, in terms of texture, F3 received the highest mean score of 2.18, described as coarse and oily. This texture of the condiment can be attributed to its oil content.

Table 5: Acceptability of the three formulations of sibujing condiment

	F1	F2	F3
Overall Acceptability	$\bar{x}$ = 7.70 Liked moderately	$\bar{x}$=7.78 Liked very much	$\bar{x}$=7.54 Liked moderately

Table 5 shows the acceptability rating of the Sibujing condiment; it shows that respondents Like Very Much Formulations 2 and 3, while Formulation 1 were Liked Moderately by the respondents. This shows that respondent preference can be attributed to the well-balanced combinations of the ingredients and well-proportion. Lawless & Heymann (2010) suggest that well-balanced ingredients play a big impact on consumer acceptability as they influence taste perception and overall satisfaction. This suggests that it is essential to achieve the right formulation in product development to meet the consumer preferences.

With the overall acceptability, consumer satisfaction metrics were also conducted to determine the end-user's satisfaction with the three formulations of the sibujing condiment. Table 6 presents the data analysis of the consumer satisfaction of the three formulations of sibujing condiment

Table 6: Customer satisfaction of the three formulations of sibujing condiment

Customer Satisfaction Based on the Characteristics	**F1** $\bar{x}$	**F2** $\bar{x}$	**F3** $\bar{x}$
Appearance	7.60	7.64	7.42
Aroma	7.65	7.64	7.48
Taste	7.56	7.58	7.50
Texture	7.50	8.48	7.40

Values represent mean ± standard deviation (n = 50)
[1]F1 – sibujing condiment with 100g sibujing
[2]F2 – sibujing condiment with 75g sibujing
[3]F3 – sibujing condiment with 50g sibujing

The table above presents the customer satisfaction of the three formulations; it indicates that F2 has the highest mean score of 7.64 regarding appearance. This suggests that respondents were highly satisfied with its visual which may have contributed to their overall acceptance of the condiment. In the research of Spence (2018) that visual appeal can influence consumer perception and preference, as color, texture, and presentation can enhance the perceived quality of food product. This implies that optimizing the appearance of food products is essential in improving consumer satisfaction and increasing marketability. For the aroma, F1 got the highest mean score of 7.65, this indicates that this formulation had the well balance proportion of ingredients which contributed to its aroma. The combinations of the ingredients enhance its olfactory factor that makes its more appealing to the respondents. As noted in the book of Lawless & Heymann (2010) that a well-balanced proportion of ingredients can improve the sensory experience which increases the consumers satisfaction. for the taste, F2 has the highest mean score of 7.58, suggesting that it had the most well-balanced combination of ingredients among the three formulation that leads to a higher acceptability rating. A well-proportion taste profile is vital in determining the consumer preference, as it enhances the overall satisfaction and palatability of the product. Likewise in the study of Prescott (2012) that combination of ingredients plays an important role in taste perception because the right balance of flavors can improve acceptability and market prospect. This result implies that F2 formulation has achieved the desirable flavor profile, making it a preferred choice among respondents. In addition, in terms of texture, F2 has the highest mean score of 8.48 which indicates a higher level of satisfaction among the respondents. This shows that F2 texture was well-

accepted due to its balance consistency and mouth feel. Szcesniak (2002) noted that texture plays a great role in influencing food acceptance and rejection, thereby affecting selection intake. Further it also stated that food texture does not only influence sensory appeal but also consumer acceptance. This clearly implies that texture is vital for product development.

Table 7: Comparison of sibujing with commercially made condiment sample X

Criterion	Sibujing Condiment SUM	Sample X SUM
Appearance	43	27
Aroma	77	3
Taste	55	25
Texture	76	4
Overall Attributes	76	4
Overall Acceptability	79	1

Values represent mean (n=80)

Table 7 presents the results of comparative summary of Sibujing condiment with a commercially prepared condiment quoted as Sample X. Among 80 respondents, 43 preferred the Sibujing Condiment's appearance which indicates a greater visual appeal. This suggest that enhancing visual attributes can boost market potential. Likewise with the research of Spence (2015) states that color and texture significantly influence consumer preference, which implies that enhancing visual appeals can boost market potential. In terms of aroma, Sibujing Condiment received the highest preference of 77 out of 80 respondents, indicating that respondents found its aroma more appealing than Sample X. This suggests that its unique blend of ingredients creates a more favorable olfactory experience, which is crucial in consumer preference. Regarding taste, Sibujing Condiment received a consumer preference of 55 out of 80, suggesting that respondents preferred its flavor compared with Sample X. This indicates that the condiment's taste profile is well-balanced and well-proportion resulting a consumer satisfaction. A properly formulated blend of ingredients can enhance taste perception, making the product more appealing and competitive. In addition, Sibujing Condiment received the highest texture preference of 76 out of 80 which indicates that respondents prefer the sibujing compared with Sampled X. This suggests that its texture, likely influenced by the balanced composition of ingredients, enhances consumer acceptability. Research states that texture is a key factor in food preference, as it directly affects mouthfeel and overall eating experience (Chen & Rosenthal, 2015). This implies that well-balanced texture can contribute to a customer satisfaction. Sibujing Condiment received the highest preference in overall attributes, with 95% (76 out of 80) of respondents favoring its sensory qualities, indicating high satisfaction. Moreover, Sibujing condiment overall acceptability garnered a preference rate of 98.75% (79 out of 80 respondents), demonstrating a clear consumer preference for Sample X. These findings emphasize Sibujing Condiment is preferred by the respondents in flavor, texture, and aroma, therefore it has a potential market acceptance and consumer demand.

Formulation 2 obtained the highest rating of overall acceptability and thus it was also the formulation which was tested for physicochemical properties analysis and nutritional analysis. Table 8 presents the physicochemical properties of sibujing condiment.

Table 8: Physicochemical properties of sibujing condiment

Physico-Chemical Properties	Results
Ash	5.43g/100g
Moisture Content	36.57g/100g
Crude Protein	3.71g/100g
Total Fat	30.75g/100g

Table 8 shows the physico-chemical analysis of Sibujing Condiment. It contains an ash of 5.43g per 100g, stipulating the presence of essential minerals. The Sibujing condiment has a moisture content of 36.57g per 100g, indicating a moderately high-water content, which may influence its texture and shelf life. Fresh chili has a moisture content of 70–80% (Handayani et al., 2022), while fresh garlic contains approximately 63% water (Sasmitaloka & Hidayat, 2022). Although research on the moisture content of Sibujing is limited, as a member of the Allium family, it is likely to have a similar water content to fresh garlic or leeks. Since the preparation of Sibujing condiments involves fresh ingredients, specifically chili, garlic, and Sibujing, this explains its higher moisture content. Since moisture content directly affects shelf life, modifying the preparation process—such as pre-drying ingredients or adjusting formulation—is recommended to enhance product shelf life. The crude protein content is 3.71g per 100g, revealing that it provides less protein. Meanwhile, the total fat content of 30.75g per 100g makes it an energy-dense product, highlighting the need for moderate consumption to balance dietary fat intake.

Table 9: Nutritional content of sibujing condiment

Food Nutrient	Result of Chemical Analysis (per 100g) *	Amount of Food Nutrient per Serving Size (Rounded Value) **	%Daily Value (based on 2000 Calorie Diet, Rounded Value) **	%REI/RNI%(based on PDRI 201 reference adult requirement of males 19-29 years old, Rounded Value)***
Calories, kcal	385.75 kcal	70 kcal		3
Calories from fat, kcal	276.75 kcal	50 kcal		
Total Fat, g	30.75 g	6 g	8	
Total Carbohydrates, g	23.54 g	4 g	1	
Protein, g	3.71 g	1 g		1

Package size =247 grams
Serving size= 1 teaspoon (about 18 grams)
Servings per container= About 14 servings
[1]Based on the Report of Chemical Analysis Certificate
[2]The %Daily Value is based on the new Nutrition Facts Label finalized May 20, 2016
[3]The % REI/RNI is based on FDA Circular 2023-0009 promulgating the adoption of PDRI 2015 as the reference on nutrition labeling of processed food products.

Table 9 presents the nutritional composition of the Sibujing condiment, highlighting its macronutrient distribution and caloric contribution per 100 grams. The analysis indicates that the condiment has a relatively high-fat content, with 30.75g per 100g, contributing approximately 276.75 kcal from fat. This accounts for about 72% of the total caloric content, making it an energy-dense product. However, the fat in the condiment primarily comes from the natural fat content of Sibujing, garlic, and coconut oil, known for its medium-chain triglycerides (MCTs) that provide energy and potential metabolic benefits (Boateng et al., 2016).

The condiment provides 23.54g and 3.71g per 100g for carbohydrates and protein, respectively. This equates to only 1% of the daily carbohydrate intake and a minimal contribution to protein needs, indicating that the condiment is not a significant source of these macronutrients. Considering typical condiment consumption, research suggests that individuals consume approximately 2–4 grams of condiments per meal (Li et al., 2021),

meaning a serving of Sibujing condiment (4g) would contribute approximately 15.43 kcal, primarily from fat.

Given its high fat content, moderate consumption, especially with meals rich in protein and fiber, is recommended to maintain a balanced diet. The median consumption of condiments per person-time in Chinese restaurants was 1.54 g of spices and 3.64 g of compound condiments (Li et al., 2021), which are composed of several spices. Therefore, condiments are consumed in 2-4 grams, implying that a person consumes approximately 4 grams when eating; therefore, sibujing condiments only provide 15.43 calories. Additionally, modifications in ingredient preparation, such as adjusting oil content, could improve the product's nutritional profile. While the Sibujing condiment enhances flavor, mindful consumption must ensure it complements a well-balanced dietary intake.

4. Conclusion

This study concludes that the sibujing-based condiment, developed through the design thinking process, is highly acceptable in terms of sensory attributes—particularly appearance, taste, texture, and aroma—and is strongly preferred over commercial alternatives. Its nutritional profile, including moderate caloric content and essential minerals, supports its value as both a healthy and flavorful condiment to meals. These findings also affirm its suitability as an instructional recipe for Home Economics education, particularly within the food preservation technology course, showcasing how local ingredients and end user-centered design can enhance curriculum relevance. This food innovation supports sustainable food practices and cultural preservation within the Maranao community and, at the same time, also serves as a model for teaching food innovation in schools. Future research may focus on shelf-life enhancement, classroom implementation strategies, and potential commercialization.

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