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Harnessing The Endoskeleton of *Chanos Chanos* (Milkfish) Into Steamed Appetizer

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Abstract

The study aimed to use Chanos chanos (milkfish) bones as an innovative ingredient in shaomai production, thereby converting an underutilized byproduct into a nutrient-rich food source while addressing environmental waste. The purpose of the study is to utilize the bone of the milkfish as byproduct into strategic commodities to fulfill the needs of nutrients that are relatively inexpensive to the consumers. Five shaomai trials using milkfish bones progressively improved, addressing issues like dough thickness, fishy odor, and sauce consistency. The five iterative experimental trials were conducted to refine the product formulation with respect to texture, odor, and sensory acceptability. The final iteration yielded a flavorful, well-textured shaomai with a perfectly balanced chili-garlic sauce. To ensure product safety and assess nutritional value, two key analyses were performed: microbiological testing to evaluate product safety for consumption, and proximate analysis to determine its nutritional content. Table 1 indicates that the product's microbial tests—showing aerobic plate count (<250), E. coli (<10), Staphylococcus aureus (<10), and yeast and mold count (60)—confirm its safety for consumption based on the acceptance criteria of 2.3 x 10^2 to 3.3 x 10^2. Meanwhile, table 2 reveals that the product, with a moisture content of (44.3%), ash content of (5.98%) and providing essential macronutrients—carbohydrates (38.5%), protein (7.94%), and fat (3.31%)—along with a moderate calorie count of (216 kcal), suggests it is a fresh, nutritious food that supports energy and nutrient absorption in a balanced diet. In conclusion, this study highlights the successful use of milkfish bone to create a nutritious shaomai that meets safety standards and offers a balanced nutritional profile, making it an affordable and sustainable dietary option.

Key words: *Chanos chanos, Shaomai, Experimental Design, Cebu, Philippines*

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Introduction

Fish byproducts have been increasingly explored as functional food ingredients due to their high mineral composition and potential for waste valorization. Chanos chanos bones are actually an alternative source of various minerals. They are particularly high in calcium, which is needed to build and maintain strong bones (Probowati et al., 2024), and phosphorus, which is needed for the growth, maintenance, and repair of all tissues and cells in the body (Mount Sinai, 2025). Moreover, it contains protein to maintain fluid balance and keep the immune system strong (Nevanda, 2023). Incorporating the bones of the milkfish into your diet can enhance mineral intake, contributing to improving muscle function, energy metabolism, and overall physiological balance. (Sriwati et al., 2019).

Chanos chanos, commonly known as milkfish, is a widely used ingredient in various culinary snacks, including milkfish satay, milkfish floss, milkfish bontot, and milkfish crackers and chips. The primary parts of the milkfish that are utilized are its flesh and skin. In contrast, the bones of the milkfish are often underutilized and regarded as waste within the industry. Daily, significant amounts of milkfish bones are produced and discarded as byproducts of the processing line, contributing to environmental pollution. These byproducts account for over 30% of the total fish processed. The fraction of fish bones typically represents about 10% to 15% of the overall body weight of the fish (Wulandari & Kusumasari, 2019). In addition, the bones discarded as waste from the milkfish processing sector and nearby locations amounted to 15 kg daily, totaling 5 tons annually (Hiijriani et al., 2015). Given that these bones have not been fully utilized, they present a significant opportunity as a byproduct for shaomai production. Existing research highlights the nutritional value of milkfish bones, rich in calcium, phosphorus, and protein, and explores various processing methods like creating Milkfish bone Baduy Regginang (Eris et al., 2020), Milkfish bone flavorful paste (Muslimin et al., 2023), Milkfish bone gelatin (Hutapea et al., 2020), and milkfish bone flour (Nuraeni , 2020). However, a significant gap remains regarding the feasibility of incorporating Chanos chanos bones into innovative shaomai.

The lack of studies specifically addressing this application limits our understanding of the potential benefits, challenges, and optimal processing techniques involved in creating shaomai using milkfish bones. This study could significantly contribute to enhancing the value of milkfish by-products and diversifying food options. Moreover, there has been a significant rise in the global production of fish waste, with estimates suggesting that approximately two-thirds of all fish caught is ultimately discarded, leading to substantial economic and environmental challenges. Consequently, the management and recycling of this waste have emerged as critical issues to address (Coppol et al., 2021). Additionally, there is a lack of understanding of the potential value and processing methods for fish bones, particularly regarding public awareness, media coverage, and industrial knowledge (Abdel-Moemin & Abdel-Rahman, 2022). In order to synthesize all the facts, the researchers are actively involved

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in utilizing the bones of the milkfish into shaomai, transforming byproducts into innovative food creation.

The goal of this study is to produce shaomai by utilizing the bone of the milkfish. The purpose of the study is to utilize the bone of the milkfish as byproduct into strategic commodities to fulfill the needs of nutrients that are relatively inexpensive to the consumers. Moreover, this study aims to reduce waste in community to promote environmental sustainability. This paper intends to contribute to the field of food industry by utilizing the bone of the milkfish into nutrition-rich food where consumers can get particular minerals for their health and overall well-being.

Methodology

Design

This study used an experimental design. This design was well-suited for studying the process of transforming Chanos chanos bone into shaomai because it allowed researchers to systematically manipulate and control the variables involved in the transformation, considering the impact on the shaomai's taste, aroma, and overall quality. By using this experimental design, researchers could establish cause-and-effect relationships and determine the specific factors contributing to the successful conversion of the bone into shaomai. Experimental design in food technology is a systematic approach used to conduct experiments and gather data to investigate and analyze various aspects of food technology. This experiment required careful planning and execution to test the hypotheses, evaluate variables, and understand the effects of different processing factors on the food product (Peigen Yu et al., 2018). The objective of this study was to produce shaomai using the bone of the Chanos chanos.

Environment

The study was conducted at the food laboratory of Cebu Technological University Malabuyoc Extension. This facility specialized to ensure food safety, security, and quality. It does expert analytical testing to verify product purity and determine health risks. The laboratory provides essential resources to uphold food safety standards effectively. The available equipment encompasses a freezer for storage, a stove and steamer for cooking, kitchen utensils for food preparation, a washing station for sanitizing utensils, a pantry for ingredients, personal protective gear to mitigate exposure to hazards, and an assortment of kitchen appliances, including a food processor, which are crucial for product creation.

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Experimental Units

This experimental unit used an entire milkfish (Chanos chanos) bone in shaomai as an appetizer. The most abundant seasonal appearance of milkfish seed is in March — July, while the less abundant season is September — December. Late in life, males reach maturity at around 4 years, while females typically do so at 5 years or older. The practice of milkfish aquaculture began approximately 1800 years ago in the Philippines and later expanded to Indonesia, Taiwan, and throughout the Pacific. Historically, traditional methods of milkfish aquaculture involved replenishing ponds by harvesting wild fry, leading to significant variations in both quality and quantity across seasons and locations. The species can be found in the fishing farm of Badian and Argao, part of Cebu Province. For the study, the researchers used the entire bone of the milkfish, and its broth extract to be experimented with. Here are the following items that were purchased by researchers to prepare the bone of the milkfish as shaomai: 1/4 kl of milkfish bone, 1 piece carrots, 1 whole garlic, 2 pieces of onions, 2 tablespoon of sugar, 1/2 knorr pork cubes, 1 large egg, 1/2 teaspoon salt and pepper, 1/8kl of chili, 2 tablespoon of soy sauce, and 1/2 flat of olive oil.

Laboratory Equipment

To process and prepare this appetizer effectively, a variety of tools and equipment are needed. The following tools and equipment were employed in this study: A steamer is a container with holes in the bottom that is placed over boiling water to cook milkfish bones with steam. A measuring spoon is used to measure an exact amount of an ingredient, such as black pepper, salt, sugar, soy sauce, cornstarch, and olive oil. Mixing bowl is a large bowl used for mixing dry ingredients like seasonings as well as milkfish bones. A cooking pot is used for boiling the milkfish bone that covers completely from all sides. A mortar and pestle is made of hard stone, such as granite, used for grinding the boiled milkfish bone. Frying Pan is a flat-bottomed pan used for frying the grind boiled milkfish bones. Portable Butane Stove is fueled with butane used for cooking milkfish bones and sauce.

Data Collection Procedure

Preliminary Preparation

The initial preparation is to granulate the *Chanos chanos* bone to create shaomai by following these steps: (1) Prepare the bone of the milkfish; (2) wash the bones in a clean running water; (3) boil the bones of the milkfish into the pot with 100°C for 30 minutes together with the leaves of guyabano, ginger, garlic, vinegar, water and lemon in order to remove the odor. After 30

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minutes, drain the first boil and boil it again for 5 minutes with a small amount of water, then add seasonings like salt and pepper to ensure the broth is clean and has no fish odor. Then after five minutes, (1) remove the fish from the pot; (2) wait for 5 minutes to cool down; (3) put the milkfish bone into a strainer to make sure small parts of bones won't fall during the process; (4) dry fry the bones of the milkfish until it turns to golden brown; (5) when the bone is already golden brown, remove it and put into a clean plate; (6) prepare your food processor if not available you can use mortar and pestle as an alternative; (7) put the bone inside to granulate, in order to eliminate the sandy texture and to achieve the main goal which is to make the bone into a fine powder.

Product Development

In a bowl, start adding the dry ingredients like flour (1/3 cup), milkfish bones (2 tbsp), carrots (4 tsp), onion (1/4tsp), magic sarap (2 tbsp), and ginger (1/2 tsp); mix it together with liquid ingredients like broth (1 tbsp), water (1 tbsp), oyster sauce (1/2 tbsp); mix well until you reach the consistency you want; prepare the 1/2 kilo of All-purpose flour, a pinch of salt, 1 tbsp white sugar for creating a hand-made shaomai wrapper; sift the All-purpose flour; put salt; put white sugar to taste; put a 1/2 cup of water; whisk little by little until not watery; put a 2 tsp. of oil; mix it by hand; put a water when it is dry and adjust the liquid; knead the dough until you achieve the desired texture; flatten the dough using a rolling pin; sprinkle the dough with flour; flatten the dough until you achieve the desired thickness; cut the dough and form into square shaped; prepare to cut the dough into small square pieces; put the mixture of fillings into the wrapper and then mold it to your desired form; prepare the steamer 21. Put the shaomai in the steamer and steam for 1 hour.

While waiting for the shaomai to steam, start preparing the ingredients needed in making the chili garlic sauce; in a pan, combine the chili (1/2 cup), garlic (1 cup), sugar (1/2 cup), magic sarap (2 tbsp), pepper (1 tsp), paprika (2 tbsp), and oyster sauce (2 tbsp) to add a flavorful complement to the shaomai; mix it first before you turn on the portable stove; make sure to low down the heat temperature to avoid candy texture. Adjust the taste if you think it still lacks seasoning; turn off the portable stove if it has already reached your desired texture; and then wait for a minute until your shaomai is cooked.

Product Packaging

To package Chanos chanos fish bone shaomai, we prefer to order it before making the product to preserve its freshness and pack it using a rectangular transparent box by following these steps:

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Prepare the shaomai for packaging; then prepare the transparent box; make sure the transparent box is clean and dry ti make the shaomai away from bacteria and safe to consume; once ensured that the box is clean and dry carefully place the milkfish bone shaomai; each box should contain 6 shaomai; put the chili-garlic sauce in a 3 oz hinge cup; carefully close the box to ensure that the product were not contaminated; seal the product to ensure product quality Once the product is ready and sealed, you can deliver it to your customer.

Figure 1. The front and back of the packaging

Figure 2. The features of the packaging

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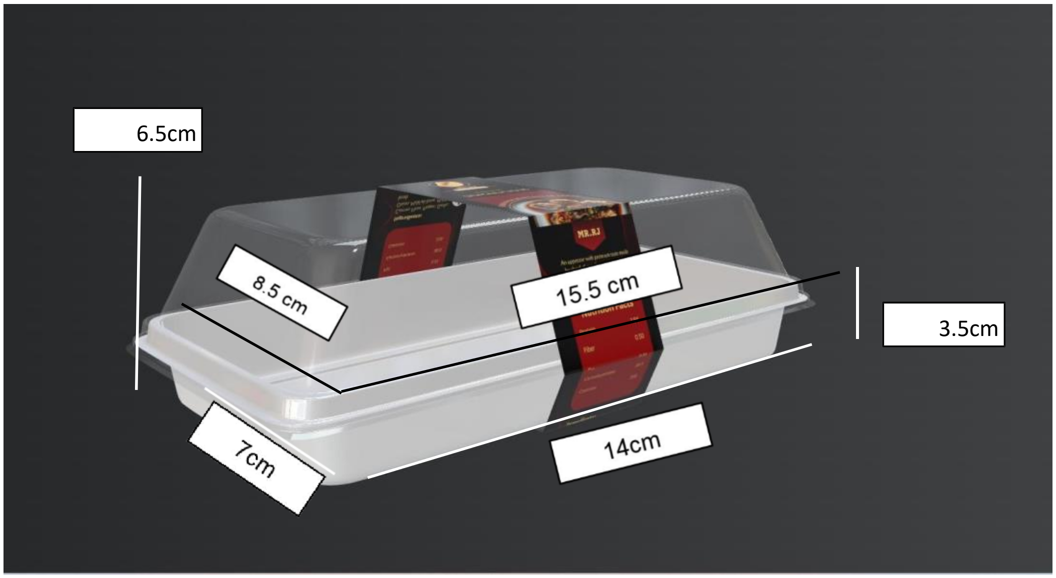

Figure 3. The dimensions of the packaging

Figure 4. The final layout of the packaging

Ethical Consideration

The utilization of Chanos chanos (Milkfish) bone waste presents a sustainable alternative for various applications. The large volume of byproduct, particularly waste bone material, from the large-scale milkfish industry ensures that harvesting this raw material would not compromise the species' conservation. Any products generated from the processing of milkfish bone waste to be used for human consumption were subjected to an extensive portfolio of stringent laboratory tests before being brought to market. The tests determine whether the material is potentially contaminated, assess its safety profile, and evaluate its use for stated purposes. Production was

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carefully regulated and done according to stringent SOPs (Standard Operating Procedures). These SOPs are intended to ensure proper hygiene and food safety at all stages of the production chain, from the initial stage of collection and processing of bone waste to the final packaging and distribution of the finished product. Examples of specific hygiene measures included in these SOPs are the protocols related to cleaning, washing, and storage of the milkfish bones at each production stage. These steps are important for preventing foodborne illness and for ensuring the product is produced under strict quality and safety standards. By taking these factors into account, we can ensure that the product is not only safe but also ethical and responsible throughout the production process.

Results and Discussion

Table 1
Microbiology Test Result

Analysis	Results	Test Method
Aerobic Plate Count, (CFU/g)	<250(Est)	Pour Plate (BAM Online)
E. Coli Count, (CFU/g)	<10(Est)	IMViC (BAM Online)
S. Aureus Count, (CFU/g)	<10(Est	Spread Plate (BAM Online)
Yeast and Mold Count (CFU/g)	60(Est)	Spread Plate (BAM Online)

Table 1 presents the product's test results. The product was tested for several parameters, and the findings show the following counts: aerobic plate count (<250), E. coli (<10), Staphylococcus aureus (<10), and yeast and mold (60). These results, falling within the acceptable range of m (2.3 x 10^2) to m (3.3 x 10^2) , confirm that the product is safe for consumption.

Table 2:
Proximate Analysis Result

Analysis	Unit	Results	Test Method
Moiture	g/100g	44.3	Air Oven Drying
Ash	g/100g	5.98	Ignition -

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			Gravimetry
Crude Protein (N x 6.25)	g/100g	7.94	Kjeldhal Method
Crude Fiber	g/100g	0.506	ANKOM Fiber Analyzer
Fat	g/100g	3.31	Mojonnier Extraction (Acid Hydrolisis)
Carbohydrates	g/100g	38.5	By Computation
Calories	cal/100g	216	By Computation

Table 2 shows the product's test results. The product was tested for moisture, ash, crude protein, crude fiber, fat, carbohydrates, and calories. The results were: moisture (44.3%), ash (5.98%), crude protein (7.94%), crude fiber (0.506%), fat (3.31%), carbohydrates (38.5%), and calories (216 kcal). Based on these results, the product contains the necessary macronutrients—carbohydrates (38.5%), protein (7.94%), and fat (3.31%)—which provide energy and essential building blocks for the body. The moderate caloric content (216 kcal) suggests it could be part of a balanced diet. The high moisture content (44.3%) indicates that the product is likely a fresh or minimally processed food. This could contribute to its overall digestibility and potentially improve nutrient absorption.

Findings

The milkfish bone shaomai contains essential amino acids, which may appeal to consumers seeking higher protein intake. Its low-fat content may attract those aiming to reduce dietary fat, including individuals following low-fat diets. The high carbohydrate content suggests it could serve as a quick energy source for athletes or those with active lifestyles. However, the low fiber content may limit its appeal to consumers prioritizing high-fiber diets for digestive health.

Conclusion

In conclusion, this study demonstrates the feasibility of using the endoskeleton of Chanos chanos (milkfish) in a steamed appetizer, resulting in a product with a unique nutritional profile. The caloric content of the shaomai was yielded from the crude protein and carbohydrates derived mainly from the milkfish bone. Its low-fat content may attract consumers interested in reducing dietary fat, though the relatively low fiber content should be noted by those who emphasize a high-fiber diet. Tests had verified that the food was safe to eat, making it a candidate for being introduced as a novel food item.

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Recommendation

Based on the findings and conclusions, the researchers present the following recommendations to improve the milkfish bone shaomai product. First, enhance fiber content by investigating the incorporation of specific fiber-rich ingredients (e.g., mushrooms, seaweed, oat bran) at varying concentrations to determine the optimal level for achieving a target fiber content while maintaining acceptable texture and taste. Explore processing techniques to enhance fiber retention from the milkfish bones themselves. Second, conduct a detailed carbohydrate analysis to determine the proportions of different carbohydrate types (e.g., starch, sugars) and assess the glycemic index (GI) and glycemic load (GL) of the shaomai. This determines its suitability for various consumer groups, including those with diabetes. Third, conduct a comprehensive cost- effectiveness analysis comparing the production costs of milkfish bone shaomai with traditional shaomai recipes, considering ingredient costs, processing time, and potential waste reduction. Assess the potential for scalability and market competitiveness. Fourth, conduct an allergenicity assessment to identify potential allergens and evaluate the risk associated with consumption.

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