International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Development and Evaluation of Tinapang Lawlaw (Sardinella Lemuru)- Kangkong (Ipomoea Aquatica) Siomai

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Unpublished Master's Thesis, Master of Arts in Industrial Education

Abstract

The development of a sustainable food system that promotes good health requires innovation and the application of various strategies and tools. This study developed and evaluated an innovative product, Tinapang Lawlaw (*Sardinella lemuru*)-Kangkong (*Ipomoea aquatica*) Siomai, using an experimental and developmental research approach. The study evaluated the microbial quality, sensory characteristics, acceptability, proximate and nutritional compositions and estimated selling price of the three formulations of *tinapang lawlaw-kangkong siomai*. The researcher performed the sensory evaluation of the three (3) formulations of *tinapang lawlaw-kangkong siomai* for the sensory characteristics quality in terms of appearance, aroma, texture, and taste using the Quantitative Descriptive Analysis (QDA) by 15 trained panelists. Acceptability of the three formulations was evaluated by 50 consumers-panelists. Formulations had a total *E. coli* count of less than 10 CFU*/g and were free from *Salmonella*. The results showed that the formulation with an equal ratio of *tinapa* and *kangkong* had the highest level of acceptability.

The proximate and nutritional composition analyses of the product revealed some promising health benefits. It contained 56.4 grams of moisture, 2.96 grams of ash, 8.51 grams of fat, and 11.3 grams of protein, making it a nutritious choice. Furthermore, it was found to have low levels of vitamin D3 and crude fiber, which could be beneficial for certain dietary needs. The estimated selling price was also found to be low, making it a potential alternative to traditional Siomai products that use meat. The study recommends further research on the marketability and shelf life of the product, as well as the development of other formulations and the use of other ingredients to improve its overall quality. The findings of this study demonstrate the potential of *tinapang lawlaw-kangkong siomai* as a sustainable and nutritious food product that can promote good health and contribute to a more sustainable food system.

Chapter 1
THE PROBLEM
Introduction

Within a food system where unhealthy options are the norm, and healthy choices are not readily available, it takes innovation to create a food that is sustainable and promotes good health. There is a wide range of strategies and tools available that could provide imminent advantages, including creative product developments, adjustments in formulation, changes in taxation and incentives, improved selection and placement of products, innovative promotion methods, clearer product labeling, worksite wellness schemes, community campaigns, nutritional programs. Although certain innovations have been shown to boost the acquisition of wholesome foods and expand the range of food choices, there is insufficient proof to substantiate a connection between these innovations and actual health benefits. Therefore, such innovation requires the management of resources that can be compelling to the consumer.

Many Filipinos rely heavily on the bodies of water surrounding the country to generate daily income. These bodies of water are highly valuable for fisherfolks. Along with revenue from agricultural goods, fishing is a good source of income, especially with an abundant catch. In addition, most people prefer to buy fish instead of meat as viand. All things considered; fish is a low-fat, high-quality source of protein. Omega-3 fatty acids, vitamin D, and vitamin B2 (riboflavin) are abundant in fish. Fish is high in calcium and phosphorus in addition to being a great source of important minerals including iron, zinc, iodine, magnesium, and potassium. Eating fish can effectively reduce blood pressure and diminish the likelihood of experiencing stroke or heart attack because of essential nutrients the fish contains. Aside from the nutrients that one can get from fish, it can also be prepared into various palatable dishes. It can be cooked fresh, steamed, fried, and even preserved through drying, canning, salting or smoking. Aside from extending shelf life of fish, smoking is believed to help retain some of the nutrients in the fish. In Bicol, smoked fish is called *tinapa.*

Tinapa is one favored way of enjoying fish by many Filipinos. Tinapa is an extremely nutrient-dense protein source that is essential for the development and maintenance of body tissues. As fish is a highly proteinaceous food, it is essential that this be retained even after being cooked to fully benefit from it. One process of retaining the nutrients is by using banana leaves when it is being smoked. Another advantage of eating *tinapa* is that it has a comparatively low-fat content in comparison to other smoked fish items. This renders it a more healthful alternative for individuals who are monitoring their caloric consumption (Leon,2021). *Tinapa* as explained by Garcia (2019), despite it being smoked, is still a rich source of essential vitamins and minerals.

Specifically, the utilization of *tinapa* as an innovative resource of dietary food for the current challenges. Proving that preventive interventions, particularly diet-related ones, lead to better health outcomes is a daunting task due to the presence of various lifestyle and environmental risks that are hard to measure and account for. Making *tinapa*, according to Leon (2021), by using the techniques of drying and smoking are economical and uncomplicated ways to preserve fish.

Tinapa, a renowned dish in Filipino food, is a delectable treat crafted from milkfish or *galunggong* that has been smoked. Wet markets or specialty stores commonly sell it along with other dried seafood options such as *daing* and *tuyo*. The word *tinapa* hails from *tapa*, a term used to signify the process of desiccating or parching food items to retain their freshness. Over the past few years, there has been widespread advocacy regarding the health benefits associated with consuming fish, with a particular emphasis on the advantages offered by *galunggong* fish. Fish is a nutritional alternative to beef or poultry due to its low levels of saturated fat. Fish species like *galunggong* offer a wealth of essential components that promote overall well-being. *Galunggong* is one fish variety that can be made into tinapa. Lawlaw is another one.

The *sardinella lemuru,* often referred to as *lawlaw* locally, is endemic in Bicol's coastal waters, especially those of Bulan and Samar (Oceana Philippines, n.d.). Bulan, a coastal municipality in Sorsogon province in the Bicol region, is located near to the Zamboanga peninsula in the fisheries management area 7 (FMA 7), which is known for its abundance of sardines, including lawlaw (Business Mirror, 2021). Fishing communities in Bulan, Sorsogon were compelled to discard an excess of *"tamban,"* leaving them to decay on the pier. In Bulan, Sorsogon, people would discard many tubs of *tamban* fish, also known as *lawlaw*, since there were too many of them. But occasionally, they are also given to the public because they aren't as marketable as meat and aren't purchased (Sethe, 2021). In the Bicol Region, a study by Earl (2017) revealed that *tinapa* is a beloved local dish among Filipinos, yet few are privy to the intricate techniques required for its production. Mercedes, located in the Bicol region, is a petite town that is anticipated for its thriving seafood industry. Every day, the local fishermen would deliver a diverse range of fish to Mercedes' fish port for either sale or processing into bagoong and *tinapa*. These small factories that are not located very far from the fish port are responsible for cooking the *tinapa*, and anyone can have the opportunity to observe the process of fermenting, drying, arranging, smoking, and loading fish onto vehicles.

To continue developing novel system-level strategies that enhance personal conduct, bolster industry and community initiatives, and synchronize policies with empirically supported guidance is a crucial advancement toward establishing a more wholesome and enduring food system. To promote better heart health through the encouragement of healthier food options, it is crucial to take swift action towards fostering positive breakthroughs throughout all aspects of the food industry. Thus, a known and abundant vegetable may be mixed and innovated into another newer dish. One vegetable in the locality is believed to be a good mix for fish – *kangkong.*

Although kangkong may share a similar name, water spinach is not closely related to the typical variety of spinach. Instead, it is a plant that is indigenous to the tropical regions of India and is commonly found in swamps and wetlands. Water spinach is a multipurpose vegetable that goes by various names such as morning glory, swamp cabbage, or water convolvulus, and is widely used across numerous Asian cuisines. Water spinach, also known as kangkong is a perennial plant that grows in aquatic or semi-aquatic environments in tropical and subtropical regions. The whole of the young plant's components can be eaten, but the tender stem tips and the young, fresh leaves are the most preferred (Tuffs University, 2023). Water spinach is commonly cooked in Asian cuisine by being stir-fried with ingredients such as fermented white bean curd, shrimp paste, or garlic.

In the Philippines, *kangkong*, the most cost-effective vegetable to cultivate, is commonly grown as a traditional crop in low-lying paddy fields by farmers. It prefers damp surroundings, which is why it thrives near streams and marshes. The said plant's pale-green stems, which are lengthy and hollow, tend to either crawl along damp earth or drift on the surface of water. Kangkong typically has elongated to heart-shaped leaves with a dark green hue that varies depending on the specific variety. In comparison to several other green vegetables, kangkong boasts a gentle and pleasant taste. To guarantee top-notch standards, the newly grown branches and leaves must be gathered before the blossoming of the plant (Calinga, 2021). Water spinach can grow pretty much anywhere, and it has a lot of nutrients in it because it is a green leafy vegetable. The preparation of kangkong dishes generally entails the utilization of condiments such as soy sauce or oyster sauce during the cooking process. The subtleness of its taste harmonizes with the savory quality of the condiments employed. Toasting garlic adds a smoky taste to the dish, which enhances its complexity.

Subsequently, various nutritional and dietary compound can be found in this vegetable where the Food and Nutrition Research Institute (FRNI) of the Department of Science and Technology (DOST) discussed that Boiling half a cup of kangkong (weighing 45 grams) yields 12.6 kilocalories and also provides essential nutrients such as 0.67 grams of protein, 23 milligrams of calcium, 11.25 milligrams of phosphorus, 0.58 milligrams of iron, 697.5 micrograms of beta carotene, 0.01 milligrams of thiamine, 0.03 milligrams of riboflavin, 0.27 milligrams of niacin, and 4.5 milligrams of ascorbic acid.

Despite the favorable circumstances, Filipino children are experiencing a rise in malnourishment, inadequate diets, and failing food systems, as stated by UNICEF. Nearly half the children between six to twenty-three months old are not given enough fruits and vegetables, whereas 59% are deprived of essential nutrients such as dairy products, eggs, fish, or meat. Their nutritional needs are not being met as they fail to consume a minimum of five out of the seven food groups. Likewise, according to the report, teenagers are consuming food that fails to satisfy their nutritional requirements in an unhealthy manner. The rate of obesity among Filipino teenagers has increased by nearly three times in the past 15 years (Philippine Expanded National Nutrition Survey, 2018) as processed foods high in salt, fats and sugar are becoming more accessible and affordable. However, there are still popular dishes, though seemingly processed, that still give good nutrition to people, especially children, like the *siomai.*

Siomai is known to be one of the complexes yet creative ways of targeting innovative products as it allows to resort ingredients in a bag. The precise etymology of *siomai* remains uncertain, as it is thought to have developed from diverse culinary traditions throughout different regions in Asia. *Siomai* is commonly thought to have originated in China and was subsequently transported to Southeast Asia during the Tang Dynasty. *Siomai* a popular dish in Chinese cuisine, is a sort of dumpling filled with meat, veggies, and seasonings. *Siomai* is thought to have originated from this dish and then spread to various regions of Asia, particularly Southeast Asia (Anko, 2021).

In terms of establishing innovation of the intake of healthy food and processed food, Shumai, also known as *siomai* in the Philippines, is a steamed or fried dumpling that originated in China. The fillings of Shumai vary based on the location. This small dish is a staple in Cantonese cooking and is widely consumed in Chinese cuisine. The Hohhot region in China's Inner Mongolia province is believed to be the birthplace of shumai, a type of dim sum. In its most basic form, finely minced pork, onion, and ginger are placed within wonton paper produced from flour and water. The filling is then visible at the top of the folded shumai dumpling, which is then pan-fried or steamed until it is cooked through.

Such delicacy according to Amanda (2022), is commonly deep-fried until it achieves a golden-brown texture, is typically loaded with various types of minced meat, peas, and carrots. Before being served, the *siomai* dumpling is topped with either hot soy sauce or garlic-infused oil. While the conventional wonton wrapper is frequently used to encase the dumpling, more upscale eateries often opt to incorporate other types of edible seaweed. Whereas this proves that Filipinos, being known to be strategic in innovating delicacies, the correlation of making *tinapang lawlaw-kangkong siomai* form will enhance the probability of allowing the public to consume greater nutritional benefits.

Expanding nutritional benefit of Siomai, Besmonte et al., (2019) stated that *siomai* commonly contains minced meat, such as pork or chicken, which serves as a rich protein source. Protein is important for the development and regeneration of bodily structures. *Siomai* recipes often incorporate vegetables, such as cabbage or carrots, which contribute fiber, vitamins, and minerals. *Siomai* can be a low-fat diet option if made with lean meat and minimal oil. Siomai can provide satiety and satiation, but it is crucial to consume it prudently as a component of a well-rounded meal. However, excessive consumption of *siomai* might result in an intake of excessive calories and lead to excessive weight gain. *Siomai* can be cooked using several cooking methods, including steaming or pan-frying, and accompanied by a variety of dipping sauces. This adaptability enables customization according to individual preferences and dietary demands.

The development of *tinapang lawlaw-kangkong siomai* focused on targeting malnutrition centered in iron deficiency leading anemia. *Tinapa*, a variety of fish that has been smoked, and kangkong, a sort of aquatic vegetable, are rich sources of vital nutrients that can effectively combat various forms of nutrient shortages or malnutrition (Armstrong, 2017). The nutritional value of smoked sardines is significant due to their high protein content and essential nutrients. Studies on smoked fish, including sardines, have shown

varying proximate compositions, with protein ranging from 37% to 46.31%, fat from 5.81% to 9.24%, and ash from 13.81% to 17.57%.
Additionally, smoked sardines exhibit low pH and Thiobarbituric Acid (TBA) values, indicating resistance to rancidity during storage. The smoking process can impact nutritional quality, with improved smoking methods preserving more nutrients compared to traditional methods. Despite variations in mineral compositions, smoked sardines generally provide essential minerals like calcium, potassium, sodium, and iron. Overall, smoked sardines offer a valuable source of protein and essential nutrients, contributing to a nutritious diet. (Adindu et al, 2022). This explained the importance of acknowledging the development of products that focus on the health benefits of the majority targeting specific health problems.
Therefore, the study developed and evaluated the product *tinapang lawlaw-kangkong siomai* for innovative but healthy product that may be acceptable to the public. This also explored ways to gain an edge over competitors, thus identified economic prospects for expansion. Staying current with the latest food safety trends can be facilitated by incorporating innovative products and processes into the food business. One goal of this research is to create delicious and healthy food using modern food innovation techniques. Another goal is to provide enough macronutrients that are required for a healthy body while maintaining the taste. This research also aimed to ensure that agricultural and distribution processes become more sustainable with each passing year. Enhanced sustainability involves safeguarding the earth and guaranteeing the opportunity for sustained food production in the future. Finally, enhancing effectiveness while reducing expenses results in decreased costs for end-users. Reduced expenses on food possess immense prospects in serving humanity as the issue of global hunger.

Statement of the Problem
The study developed a new product, *tinapang lawlaw-kangkong siomai,* and evaluated it.
Specifically, it answered the following questions:
1. What is the Microbial load of the three (3) formulations for *tinapang lawlaw-kangkong siomai* in terms of:
a. *Escherichia coli* Count; and
b. *Salmonella* Count?
2. What are the sensory characteristics of the three (3) formulations of *tinapang lawlaw-kangkong siomai* in terms of:
a. Appearance;
b. Aroma;
c. Taste; and
d. Texture?
3. What is the acceptability of the three (3) formulations of *tinapang lawlaw-kangkong siomai* formulations in terms of:
a. Appearance;
b. Aroma;
c. Taste;
d. Texture; and
e. General Acceptability
4. What is the proximate and nutritional compositions of the most acceptable *tinapang lawlaw-kangkong siomai*?

a. Protein content;
b. Moisture content;
c. Ash content;
d. Fiber content;
e. Fat content;
f. Carbohydrates content;
g. Vitamin A; and
h. Vitamin D3?

5. What is the estimated selling price of the most acceptable formulation of *tinapang lawlaw-kangkong siomai*?

Scope and Delimitation

This study utilized experimental method which focused on the development and evaluation of *tinapang lawlaw-kangkong siomai*. *Tinapang lawlaw*, and aquatic *kangkong* were the main composition of the *siomai*. In this study, 5 questions were established.

First was the identification of Microbial load of the three (3) formulations for Tinapang Lawlaw-Kangkong Siomai in terms of: (a) *Escherichia coli* Count; and (b) *Salmonella* Count. Followed by sensory characteristics as to (1) Appearance (2) Aroma (3) Taste and (4) Texture. Next is the acceptability of formulation as to (1) Appearance (2) Aroma (3) Taste (4) Texture; and (5) General Acceptability. The proximate and nutritional compositions were also evaluated as to (1) Protein content (2) Moisture content (3) Ash content (4) Fiber content; (5) Fat content (6) Carbohydrates content (7) Vitamin A and (8) Vitamin D_3 and the estimated selling price of the most acceptable formulation of *tinapang lawlaw-kangkong siomai*.

A sensory evaluation of the three formulations was conducted to determine the sensory characteristics of *tinapang lawlaw-kangkong siomai* in terms of the Quantitative Descriptive Analysis (QDA) with 15 trained Panelists from BTVTED students and Faculty from Bicol University College of Industrial Technology.

The formulations were subjected to consumer acceptability to determine the most acceptable product. Similarly, the cost of the most acceptable formulation was assessed to determine the estimated selling price for *tinapang lawlaw-kangkong siomai* future market potential.

Other factors, such as commercial viability and additional inferential statistics related to sensory evaluation, which may contribute to the acceptability and scoring by the panelists in the study, were not part of the study's aim and were not mentioned.

Significance of the Study

Although voluntary, implementing approaches on a large scale can have a positive effect on the health behaviors and outcomes of the population. Smartly rephrased: while interventions at the point of purchase in various environments such as restaurants, supermarkets, worksites, and schools have shown success in changing food choice behavior, there is a lack of data about actual health outcomes. By using statistical modeling, one can anticipate a decrease in illnesses due to the implementation of incentives for consuming vegetables and allowing on-the-go food consumption. Therefore, the development of new products is rampant in today's time.

Therefore, this study will give significant contributions to the following groups of beneficiaries:

Consumers. The findings of the study will give consumers the option of selecting *siomai,* a budget friendly and nutritious food. Subsequently, by drawing on past research and literature, this study aimed to equip consumers with knowledge and understanding of the nutritional value, health advantages, and general characteristics of the product.

Entrepreneurs. This study will provide ideas for a small business-like food sector in expanding their business and by promoting innovative products through utilization of the product that can generate income which will improve the economic value of *tinapang lawlaw* and *kangkong*. With such, the primary beneficiaries of this research are the aspiring vendors and entrepreneurs seeking to establish a business, as it will furnish them with innovations for refining and augmenting their products.

Farmers. The result of this study will be helpful for them, especially on their income and in the production of water spinach. Subsequently, farmers will be able to establish a more enhanced way of managing water spinach development for the advantage of consumers.

Tinapa Processors. This study provide an improved demand for *tinapa* in the market and an extra income for the producers. It will inspire them to increase their production to meet the market demand.

Future Researchers. The result of this research will serve as a guide for them to develop other locally produced products that are low-priced and nutritious. This can also serve as reference and related study in conducting product development in future researcher.

Chapter 2

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter presents the related literature and studies deemed relevant to the present study. Also included here are the synthesis of the state-of-the-art, the gap bridged by the study, the theoretical framework, the conceptual framework, and the definition of terms.

Related Literature

The following review of literature has provided important insights and background in the development of *tinapang lawlaw-kangkong siomai.*

The use of smoking in conjunction with salting and drying can create a physical barrier on food that can limit toxin production and inhibit germ growth by decreasing water activity. The spoilage and pathogenic microflora of smoked items can be influenced by the density of smoke, the level of active components present in smoke, as well as the salt content, time, and temperature of smoking. This has been confirmed by Andres (2019) stating that the color and flavor of smoked fish are altered. The aroma, flavor, and visual features of smoked fish are distinct and exceptional. At present, smoking is mainly employed to generate a superior sensory sensation. Several commonly used techniques, such as salting, drying, and smoking, are employed in the smoking process, and the final product is typically sealed through various packaging methods, such as vacuum sealing, modified atmosphere packaging, or controlled environment packaging. Traditionally, the process of smoking fish involved the usage of a considerable quantity of salt to diminish the moisture content. Corporations have modified their production techniques to produce products that are low in sodium, in response to the demands of consumers.

According to Fitri (2021), drying refers to the process of eliminating moisture from fish. The term "drying" usually implies water loss by evaporation, but there are alternative ways to eliminate water, including salt absorption and fish pressure treatment. The removal of water can be employed as a method of preservation, as it causes a delay or halt in the microbiological or autolytic activity that is necessary for the functioning of all living organisms. To enhance the water phase salt (WPS) and bolster the overall texture of the product, the flesh is dehydrated both before and following the smoking process, serving to extract

unwanted moisture. The process of drying can be influenced by various factors, including temperature, moisture levels, airflow speed, and properties of the substances being dried.
There are different ways to classify smoking methods based on how the smoke is introduced into products. The conventional approach involves burning solid wood chips or sawdust in an oven to create smoke, while the modern method employs an electric field to speed up smoke deposition on ionized smoke particles or uses liquid smoke flavorings that are commercially available. Smoking can be categorized into three different types - hot smoking, warm smoking, and cold smoking, which are determined based on the temperature used for smoking. The fundamental purpose of cold smoking is to infuse a smoky flavor into the product, whereas hot smoking involves cooking the product using heat in addition to adding smoke. Consequently, it is unnecessary.
Therefore, cooking hot smoked fish before consumption because it is ready-to-eat food is a great deal for the community. The quality of smoked fish is affected by raw material, salting method, bringing concentration condition processing, composition of smoke, smoking method, smoke agents, and storage conditions (UNESCO, 2017). For hundreds of years, fish has been preserved by smoking. To keep the fish from deteriorating, fishermen used smoke and salt. After processing, proper cleanliness and cold storage are also required.

Figure 1
The Lawlaw Smoked Fish (Tinapa)

Preparing fish by smoking is a widely favored method. Smoked fish is the term used to describe fish that has undergone the process of curing through smoking. Smoking, known as one of the oldest methods of preservation, combines the actions of drying, heating, salting, and smoking. Smoking fish involves utilizing fire as a method. Fish, being a type of protein food, necessitates careful handling.
Smoked mackerel offers a delectable and convenient means of conserving a type of fish that is often captured in significant amounts. Mackerel, due to its small size, is often smoked as a whole or transformed into a paste for culinary purposes.
The current study should have no trouble incorporating smoked fish (Tinapa) as it is easily accessible to the researcher and obtainable all year round.

Table 1

Nutritional Content of Lawlaw Smoked Fish (Tinapa)

Nutrition Facts for a Serving Size of 100 grams	
Calories	266 kcal
Carbohydrates	0 mg
Omega 3 fatty acids	956.0 mg
Omega 6 fatty acids	188 mg
Protein	44.1 g
Vitamin A	823 IU
Vitamin C	1.7 mg
Vitamin D	479 IU
Vitamin K	0.2 mcg
Vitamin B12	13.2 mcg
Vitamin B6	0.4 mg
Calcium	458 mg
Iron	3.9 mg
Magnesium	70.3 mg
Phosphorus	572 mg
Sodium	720 mg
Copper	0.3 mg
Selenium	0.1 mg
Zinc	1.9 mg
Manganese	0.1 mg
Choline	162 mg
Flouride	71.6 mcg
Fat	12 g

As per the research team led by Heben (2018), the round scad or mackerel scad, commonly referred to as *lawlaw*, is a well-known fish species in the Philippines. Numerous techniques are available for cooking *lawlaw*, but the prevailing approach involves presenting it as smoked or pan-fried fish paired with rice that is steamed. Like other fish varieties, *lawlaw* is packed with a diverse range of nutrients, including minerals and protein, which means that consuming this type of fish can provide numerous impressive health advantages. The nutritional benefits of *lawlaw* are so highly regarded that prominent institutions such as the WHO advocate for the daily consumption of a serving of fish, especially among expectant mothers and young individuals.

According to the Kiddle Encyclopedia (2022), several types of fish are commonly referred to as mackerel. Most mackerels belong to the Scombridae lineage and dwell in pelagic waters, spanning across both temperate and tropical oceans. Most mackerel reside in the coastal regions or the open sea and can be distinguished by their vertical markings on their backs and distinctively shaped, deeply divided tails. Despite their great swimming abilities, mackerel frequently falls prey to bigger predators like cod, dolphins, and sharks. Rich in omega-3, mackerel is an oily fish. Mackerel meat is highly susceptible to spoilage, particularly in hot regions, which can lead to foodborne illnesses. Therefore, it is advisable to consume the catch on the same day it is obtained unless it has been preserved in salt or stored in a refrigerator.

In addition, Cleveland Clinic (2019) discussed that the body cannot produce Omega-3 fatty acids, a type of fat that is externally obtained, so it has to be consumed from food. These fatty acids are a vital type of fat that plays a crucial role in ensuring survival. The consumption of food provides us with the necessary omega-3 fatty acids, which are present in fish in two forms - eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Omega-3 fatty acids found in plants are known as alpha-linolenic (ALA) and studies have shown their potential to enhance cardiovascular well-being. Although most studies focus on EPA and DHA, it is important to note that ALA can also have positive effects on one's well-being. Integrating omega-3 fatty acids into the diet yields a multitude of advantages, such as diminishing the likelihood of cardiovascular disease, decreasing the probability of fatality if cardiovascular disease is present, lowering the risk of abrupt cardiac death stemming from abnormal heart rhythms, impeding blood clotting due to these fatty acids' ability to discourage platelets from coagulating, and preserving the integrity of artery linings by averting damage that may facilitate thickening and hardening.

Moreover, in the study by Megan (2018), it has been asserted that Vitamin K plays a crucial role in promoting heart health due to its numerous advantages. It is vital to support the process of blood coagulation, which explains why it is administered to newborns during the delivery process. Moreover, this substance can impede the progression of arterial sclerosis or the accumulation of calcium in bodily tissues and linings. Vitamin K supports the development of strong bones, leading to a reduced risk of conditions such as osteoporosis. Like vitamin D, a large portion of individuals exhibit a deficiency in vitamin K. A balanced consumption of vitamin K is crucial to ensure proper blood coagulation, while also minimizing the possibility of numerous other health hazards.

Renowned for its high content of carotene, vitamin A, iron, calcium, vitamin B, and vitamin C, *kangkong* is also used as a salad, side dish, and viand. Additionally helpful to those with diabetes and hypertension, *kangkong* is being produced at an increasing rate.

Figure 2

The Kangkong

Kangkong leaves are high in vitamins and minerals and are therefore very nutritious. The East-West (2018) stated that Dietary fiber, protein, calcium, iron, vitamin A, and vitamin C are all found in abundance. Young *kangkong* leaves are great leafy green vegetables for anemia sufferers and pregnant women who require iron in their diets. Apart from being a mild laxative when consumed on an empty stomach, kangkong has no negative effects. The laxative properties of kangkong make it ideal for persons suffering from constipation.

Moreover, as explained by the University of Adelaide (2015) factsheet, there are two varieties of kangkong: Ipomoea reptans is a species of upland plant found more frequently in the Pacific region, suited for damp soils. In contrast, Ipomoea aquatica, known as kangkong, thrives in flooded environments. Two categories are acknowledged. The red kangkong plant has dark green leaves with purple patterns on the veins, the petiole, and branches, along with light purple through white flowers. This kind usually occurs in its natural habitat in tropical regions, Southeast Asia, which indigenous individuals harvest for sustenance. The white kangkong is characterized by green and white stems with petioles, green foliage, and white blooms. It is often grown. A pair of cultivars are acknowledged, one with broad blades and the other with small sharp leaves.

Hence, according to Santosh et al. (2022) Kangkong, also known as Ipomoea aquatica, is a versatile vegetable widely consumed in Asia. It is a heat-tolerant plant that can be affected by global warming, potentially impacting its growth and yield. Kangkong seeds, rich in protein and fiber, can be fermented using Rhizopus oligosporus to enhance their nutritional value, increasing crude protein content significantly. However, heavy metal contamination poses a threat to Kangkong, affecting its mineral nutrient absorption and potentially making it deficient in essential nutrients when grown in contaminated environments. Efforts have been made to innovate Kangkong products, such as Kangkong sticks, to address issues like unvaried taste and limited market scope, leading to increased sales and product popularity.

Table 2 on the next page shows the vitamins and minerals present in *kangkong* per 100g. which emphasized that *kangkong* was best prepared fresh/uncooked as this established the accurate nutritional value. Additionally, after being thoroughly washed during the procedure, the succulent and tender tips can be consumed in salads or blended into beverages. For optimal preparation, it is recommended to steam, boil, fry, or bake leaves that are moderately aged. Sections of stems can be utilized in a stir-fry recipe. Kangkong is widely known for its medicinal properties, which not only shield the liver from harmful substances such as lead, cadmium, arsenic, and carbon tetrachloride, but also have anti-diabetic benefits.

Table 2

Fresh, raw leaves of kangkong (Ipomoea aquatica) with a nutritional value per 100g.

Principle	Nutrient Value	% of RDA
Energy	19 kcal	1%
Carbohydrates	3.14 g	2%
Protein	2.6 g	4.5%
Total Fat	0.20 g	1%
Cholesterol	0 mg	0%
Dietary Fiber	1 g	5%
Vitamins		
Folates	57 µg	14%
Niacin	0.900 mg	5.5%
Pantothenic acid	0.141 mg	3%
Pyridoxine	0.096 mg	7%

Riboflavin	0.100 mg	8%
Thiamin	0.030 mg	2.5%
Vitamin A	6300 IU	210%
Vitamin-C	55 mg	92%
Electrolytes		
Sodium	113 mg	7.5%
Potassium	312 mg	6.6%
Minerals		
Calcium	77 mg	8%
Copper	0.023 mg	2.5%
Iron	1.67 mg	21%
Magnesium	71 mg	18%
Manganese	0.160 mg	7%
Phosphorus	39 mg	5.5%
Selenium	0.9 µg	1.5%
Zinc	0.18 mg	1.5%

Source: USDA National Nutrient database. *https://fdc.nal.usda.gov/fdc-app.html#/food-details/2460877/nutrients*

Siomai, a delectable Chinese delicacy, is prepared using mutton buds, garlic, crab, and pumpkin as key ingredients. Chinese people craft and distribute *siomai* with various flavors to partake in religious observances and festivities. Initially, individuals vended meat and vegetables enclosed in delicate layers, which were peddled to pedestrians strolling by on the streets (Crisologo,2022). Hence, Alfaro et al., (2020) stated that *siomai* in the Philippines comprises a blend of pork, beef, shrimp, and garlic, along with peas and carrots. The food can be prepared by either being steamed or fried until it has a crispy external texture. This dish is typically accompanied by a combination of soy sauce, fresh calamansi juice, and a piquant blend of garlic and oil for those who prefer a more assertive flavor. *Siomai* has been modified by using nori sheets in place of wanton wrappers.

Figure 3
Siomai

As revealed, Martin (2023) stated in terms of marketability and profitability that *siomai* house franchising is one of the most successful food cart franchises in the Philippines. Since 2004, the company has established more than 800 outlets in Metro Manila and the neighboring provinces of Luzon, with franchising comprising nearly 90% of its total number of outlets. For entrepreneurs, siomai is an alluring choice since it is reasonably priced and straightforward to establish and manage a business. *Siomai* is a widely loved food item, and hence there is great scope for profitability. Moreover, the elements employed are commonly affordable and readily available, thereby facilitating the maintenance of budget-friendly expenditures. Through adept marketing techniques and appropriate pricing tactics, siomai has the potential to bring in considerable profits.

Subsequently, EMC (2023) suggested that The Philippines has shown great fondness towards this product due to its distinctive taste and absence of additives. Soimai stands out as a great option owing to its rich taste profile and substantial texture. It has become a favorite delicacy among Filipinos, often served during festivities and significant events. It is a customary food item that is often included in celebratory gatherings. A well-liked cuisine in the Philippines is made by mixing minced pork, beef, shrimp, and other fillers, then wrapping them in wontons and cooking them through frying or steaming. Siomai usually consists of a delicate dough that is thinly flattened and then stored in a frozen environment until it is ready to be cooked. The hue of the wrapper can either be yellow or white, contingent on whether the mixture incorporates an egg. The siomai boasts a unique texture that is both tender and succulent due to how it is stuffed and enveloped. One key factor behind the crunchy coating of siomai lies in its post-serving preparation, which pleases many of its enthusiasts.

Whereas tuna *siomai*, illustrates the adaptability and inventiveness in the culinary world by combining the classic Chinese dim sum with the contemporary taste for lighter, protein-rich dishes. Tuna, known for its abundance of protein, minimal saturated fat, and abundant omega-3 fatty acids, is an excellent choice to generate a healthier version of *siomai*. This approach meets the dietary needs of health-conscious consumers, pescatarians, and those sensitive to their meat intake (De Vera, 2019).

Moreover, Carolino et al. (2021) stated that tuna *siomai* is made by carefully combining small pieces of tuna with several ingredients like chopped vegetables (carrots, spring onions), sesame oil for a nutty taste, and a variety of seasonings for aroma enrichment. Afterward, this blend is encased in delicate layers of dough, typically made from wheat, and steamed until cooked perfectly. The outcome is a juicy and tasty bite that satisfies the taste buds and provides nourishment. Tuna siomai not only offers health benefits but also symbolizes a sustainable option in the culinary industry. Given the rising worries about the environmental effects of meat production, increasing the consumption of seafood, especially from sustainable origins, offers an environmentally friendly option. Responsibly produced tuna provides a sustainable dining choice to meet the growing demand.

To expand, in terms of nutritional composition, popularity depends on the size and type of *siomai*. In one serving of *siomai* specifically the tuna *siomai* as indicated by a well-known fitness application fitness pal in collaboration with My Net Diary (2024), the nutritional information of this food item displays 210 kCal in 3 pieces serving with 12g total carbs, with existing 11g of protein, 0g fat and other supplemental.

Table 3 shows the nutritional content of the tuna siomai available in the market, this revealed high content of protein favorable content for an innovative healthy product. Therefore, such comparison was needed to determine what content must be supplied to manage the advantages of such content. Thus, among Filipinos, being knowledgeable about the type and quantity of food one consumes is essential for attaining and preserving a healthy physical state.

Table 3

Nutritional Content of Tuna Siomai in 3 Pieces Serving

Nutrient	Value

Calories	210 kCal
Total Carbs	12 g
Net carbs	12g
Fiber	-
Starch	-
Sugar	-
Sugar Alcohol	-
Protein	11 g
Fat	0
Cholesterol	
Supplemental	
Potassium	63 mg
Sodium	560 mg
Vitamin A	60 mcg
Calcium	20 mg
Iron	0.7 mg

The RENI serves as a reference for suitable amounts of 21 vital nutrients and energy, such as calcium, zinc, protein, and folate, to sustain good health and overall well-being for nearly all individuals in the general population.

For instance, the iron requirements of women surpass those of men, and a pregnant woman necessitates a greater amount of essential nutrients than a woman who is not expecting. In addition, it is optimal to regularly consume certain nutrients such as those that are water-soluble, including vitamin C. Exceeding the recommended dosage of some nutrients such as vitamin A can have negative consequences; however, other nutrients can be detrimental if consumed excessively.

Table 4
The Required RENI Intake among Filipinos

Life stage/ age group	**Weight (kg)**		**Energy (kcal)**		**Protein (g)**		**Essential Fatty Acids** a-Linolenic Acid (%E)	**Linolenic Acid (%E)**	**Dietary Fiber (g)**	**Water (mL)**	
	M	**F**	**M**	**F**	**M**	**F**				**M**	**F**
Infants, mo											
0-5	6.5	6.0	620	560	9	8	0.5	4.5	-	680	680
6-11	9.0	8.0	720	630	17	15	0.5	4.5	-	890	890
Children, y											
1-2	12.0	11.5	1,000	920	18	17	0.5	3.0	6-7	1,000	920
3-5	17.5	17.0	1,350	1,260	22	21	0.5	2.0	8-10	1,350	1,260
6-9	23.0	22.5	1,600	1,470	30	29	0.5	2.0	11-14	1,600	1,470
10-12	33.0	36.0	2,060	1,980	43	46	0.5	2.0	15-17	2,060	1,980
13-15	48.5	46.0	2,700	2,170	62	57	0.5	2.0	18-20	2,700	2,170

16-18	59.0	51.5	3,010	2,280	72	61	0.5	2.0	21-23	3,010	2,280
Adults, y											
19-29	60.5	52.5	2,530	1,930	71	62	0.5	2.0	20-25	2,530	1,930
30-49	60.5	52.5	2,420	1,870	71	62	0.5	2.0	20-25	2,420	1,870
50-59	60.5	52.5	2,420	1,870	71	62	0.5	2.0	20-25	2,420	1,870
60-69	60.5	52.5	2,140	1,610	71	62	0.5	2.0	20-25	2,140	1,610
≥ 70	60.5	52.5	1,960	1,540	71	62	0.5	2.0	20-25	1,960	1,540
Pregnant				+300*		+27					+300
Lactating				+500		+27					+700

NOTE: Recommended Nutrient Intakes (RNI) are in bold font, while Adequate Intakes (AI) are in italics. *For 2nd and 3rd trimesters only. Philippine Dietary Reference Intakes 2015 *(https://www.pclm-inc.org/uploads/2/0/4/0/2040875/pdri-2018.pdf)*

Related Studies

The following studies were reviewed and were found significantly related to the present study to as basis and background for the innovation and development of healthy *siomai* among consumers

Agripa et al. (2016) conducted a study entitled, "The Acceptability of Banana Flower as Siomai". The primary objective of the research was to create a novel item utilizing a banana flower in the form of *siomai*. The principal goal of the research was to assess the level of approval about sensory attributes such as visual appeal, fragrance, flavor, and consistency. With regards to visual appeal, the steamed *siomai* of Sample 1 achieved a 55% rating, which was deemed satisfactory by the panelists. On the other hand, Sample 2, and Sample 3 both received a 50% rating in terms of appearance. Out of all the samples, sample 3, which was prepared through a combination of steaming and frying, had the most noticeable aroma with a staggering 70% score. Among the three samples, fried siomai scored the highest percentage of 85% in terms of taste, compared to 60% for sample 1 and 55% for sample 3 which is a combination of steamed and fried siomai. Sample 2's fried Banana Flower siomai received the top score of 85% in terms of its texture, indicating that panelists found it to be highly satisfactory.

The study of Cantes et al. (2008), Coconut (*cocosnulifera*) Into Siomai: A Development Study focused on development of the coco *siomai* by utilizing the coconut meat. This research investigated whether utilizing a small quantity of fish or meat and various other components in medium mature coconut flesh results in siomai that is viewed as acceptable. The evaluation criteria were primarily sensory attributes, considering factors such as appearance, fragrance, flavor, and consistency. The product is subjected to a proximate composition analysis to ascertain its nutrient content. The findings reveal a protein content of 7.63% and fiber content of 5.03%. The substance contains 15% fat and 1.73% ash. The addition of meat to the product resulted in a high fat content. As a result of being cooked using steam, the moisture content of the food is notably elevated. Yet, the flavor resembled that of the pre-existing meat-filled dumpling. It has the option of being steamed or fried.

Penilla (2012) developed "Sweet Potato Siomai" which focused on the utilization of sweet potato as the main ingredient of the *siomai*. Sweet potato *siomai* is crafted by combining minced pork, mashed sweet potato, carrots, and varied seasonings that are delicately enclosed in a siomai wrapper. It was discovered that siomai served with a mashed camote is preferred in terms of flavor and taste, receiving the most positive feedback due to the subtle taste of sweet potato. Most participants favorably reviewed the product for its texture.

The study of Bantog (2019) was about *tinapa-malunggay* noodles. The main goal of this research was to create noodles that have an increased nutritional value with the use of *tinapa* and *malunggay* powder. The sequence of procedures was likewise listed: starting with defining the main components, followed by producing various samples using the same method. The sensory aspects of the samples were evaluated relating to their appearance, fragrance, taste, and texture, ultimately identifying the most favored sample. The elements of protein, total fats, ash, moisture, crude fiber, and carbohydrates were analyzed for the sample that met the criteria. In addition to this, customer acceptance was also assessed, and the production cost of the preferred sample was estimated.

According to the findings, the *tinapa-malunggay* noodles displayed the following sensory traits: a tint of light green in the color, a moderate yet noticeable *tinapa* scent, a pronounced *tinapa* flavor, and a firm texture. Out of all the choices, sample 3 - consisting of 30 grams of *malunggay* powder, 220 grams of all-purpose flour, and 2 tablespoons - was the most popular option. Moringa is another term for *malunggay*. The nutrient composition of *tinapa-malunggay* noodles, which includes protein, total fats, ash, moisture, carbohydrates, and crude fiber, has significant value due to the addition of *tinapa* and *malunggay* powder in the noodles.

Huong (2017) employed wood smoke and commercial liquid smoked flavoring to smoke Atlantic mackerel for his study, "The Effect of Smoking Method on the Quality of Smoked Mackerel." The mackerels were vacuum packed and then stored at -1°C for seven days after they were smoked. Afterward, the temperature was raised to 4-5°C, and this was maintained for the subsequent three weeks. Observations were made on changes in various aspects, such as sensory attributes (including odor and flavor), physical properties (including color and texture), microbial factors (including total plate counts), and chemical properties (including total lipid, peroxide value, thiobarbituric acid reactive substance, and free fatty acids) during a period of chilled storage spanning 0-4 weeks. The smoked mackerel, made using commercial liquid smoked flavors, exhibited characteristics such as lightness, red and yellow hue, and a milder scent than the wood-smoked variety. Additionally, there was reduced bacterial growth in the liquid smoke product, but it increased substantially during refrigerated storage. Although the lipid oxidation increased following the use of wood smoke, it remained relatively steady throughout the period of refrigerated storage. Compared to wood-smoked mackerel of the same salt content and water activity level, the duration of lipid oxidation in liquid-smoked mackerel was found to be shorter, lasting only three weeks as opposed to at least four weeks.

Gradenda (2007) did a study on *kangkong* pickles which was undertaken to investigate the possibility of processing *kangkong* into pickles “considering kangkong as available as long a year around as its main ingredient, the investigation uncovered alternative applications for the *kangkong*, apart from being a mere component of a vegetable dish, as there are two garment-related utilizations that are distinct from it. The main aim of this study was to determine the ideal ratio of components needed to produce high-quality *kangkong* pickles, as well as evaluate their desirability based on their flavor, appearance, and texture. Additionally, the study identified the distinct features of these pickles. According to the findings, the ratio of 1:1 for the preparation of *kangkong* pickles was deemed satisfactory by the participants. The participants judged the fermented and non-fermented varieties of *kangkong* pickles to be satisfactory in taste, given that both had a moderate level of sweetness and sourness. Additionally, they noted that the color of the kangkong was green. The present research is allied to this study as both researchers utilized *kangkong*, as the primary ingredient in creating *tinapang lawlaw-kangkong siomai.*

The study of Martus et al. (2014) entitled, "Water Spinach Ice Cream" developed ice cream by utilizing *kangkong* as the main ingredient. Based on the result, there were two (2) proportions in making water spinach ice cream sample 1 contains ¼ tsp salt, 3 pcs egg yolks, 1T vanilla, 2C all-purpose cream, 1 can condensed milk, and ½ C *kangkong* juice. Sample 2 contained the same amount of ingredients aside from *kangkong* juice which was increased to 1C in sample 2.

Concerning the sensory aspects of ice cream made with *kangkong*, it was observed that sample 1 had a darker green color compared to sample 2 which had a lighter shade of green. The fragrant essence of both samples 1 and 2 was mild. The judges found the flavor of sample 2 water spinach ice cream to be quite satisfactory, and its overall traits were favorably assessed.

Synthesis of the State of the Art

The foregoing related literature and studies in both foreign and local settings distinctly showed relevance to the present study, particularly in developing a new variant of *siomai*. Moreover, such comparison and relation added substance to the current study as it further strengthened the impetus to innovative products. There were many studies conducted and reviewed in the conceptualization of this study in terms of raw materials, objectives, methodology, and product output. These studies proved helpful as the basis for the completion of the present study, particularly the studies of Bantog (2019) and Huong (2017) which focused on utilizing fish in their studies. Bantog (2019) used tinapa in making the *tinapa-malunggay* noodles. The present study also used *tinapa*, but in a different in product.

Also related are the studies of Cantes et al. (2008), Agripa et al. (2016), and Penilla (2012), because they made siomai. Objectives were likewise similar, but they did not include the production costing.

The study conducted by Martus et al. (2014) and Gradenda (2007) contributed much to the present study because both studies used *kangkong* as one of their main ingredients.

Gap Bridged by the Study

The foregoing review of the related studies shows several similarities to this present research but, there are also differences. Primarily, the current study differed from the previous research in terms of the flavoring ingredients used, the specific objectives, the research methods, the process and even the theoretical frame; however, the chief similarity lies on the use of *tinapa* and *kankong* in some of the studies reviewed. Moreover, the review reveals that there has not been a single instance where *tinapa* and *kangkong* have been used as the primary components in any *siomai* merchandise available in the market, and this is the void that the research aimed to fill.

Theoretical Framework

This study was anchored on the principle of product acceptability, the principle of food processing, including the subjective and objective evaluation to come up with *tinapang lawlaw-kangkong siomai*.

According to the study of Giovanny et al. (2016), product acceptability is crucial in determining consumer behavior and decision-making. Factors such as perceived quality dimensions, net promoter score, and visual cues like color differences can significantly influence product acceptability. Additionally, the product acceptance process plays a vital role in quality management, especially in statistical quality control and reliability tests. To enhance product acceptability, it is essential to evaluate users' needs and preferences early in the New Product Development process, to ensure the product aligns with consumer expectations. The principle of creating a new and enhanced product may either result in an improvement of an existing product or the creation of a brand-new product with exceptional qualities. This principle is relevant to the current research, that aims to develop a new product - *tinapang lawlaw-kangkong siomai*.

Subsequently, the theory suggests that the purpose of subjecting food to controlled conditions through food processing is to transform it into a state that is safe, enduring, and convenient. In this study, the application of low and high temperature preservation methods significantly impacts the nutritional content of food. Low-temperature preservation techniques, such as low-temperature cooking programs, help in preserving food substances better, resulting in higher nutritional advantages of culinary products. Conversely, high-temperature preservation, like pasteurization, is a common method that can destroy microorganisms but may lead to a reduction in nutrients due to the heat treatment process. Additionally, the use of suitable low temperatures and high humidity in preservation apparatuses can maintain the appearance quality and main nutrient content of edible fungi, extending their shelf life without the need for chemical preservatives. Overall, the choice between low and high temperature preservation methods plays a crucial role in determining the nutritional quality and shelf life of food products. (Bortsova & Lavrova, 2021). It adds to the taste of the food and makes it more enjoyable to eat. The key element that should be given the utmost attention for achieving superior outcomes is the processing of food.

Given that the research involved a combination of two primary components, namely *tinapa* and *kangkong*. The researcher endeavored to create a new type of *siomai* – the *tinapang lawlaw-kangkong siomai*, through innovative methods of ingredient preparation and combination. This was based on the recognition that the characteristics of food change when exposed to various processes and preparation practices. The researcher devised distinct methods and observed the impact on the characteristics of three variations of *tinapang lawlaw-kangkong siomai.*

To add, the study was also anchored on the principle of subjective and objective evaluation. Subjective evaluation in food involves assessing foods based on personal perceptions and preferences, while objective evaluation relies on measurable criteria like nutrient content. Research indicates that naturalistic categorizations of food are primarily driven by subjective assessments of qualities like processing level and taste, rather than objective nutrient values. (Carrington et al., 2020). This methodology involves various approaches that ensure a precise assessment of individuals' reactions toward food while reducing any potential influence stemming from brand identity or other external information that might impact their perception. It is crucial to identify the attributes of any food item that is intended to be marketed and sold to the public.

This principle was one of the fundamental principles utilized in the present study particularly in the development of the *tinapang lawlaw and kangkong into siomai*. The principles used were product acceptability, application of low—and high-temperature preservation, and subjective and objective evaluation to develop a new product out of *tinapang lawlaw-kangkong siomai* to establish an innovative, healthy product that may be acceptable to the public.

Conceptual Framework

The aforementioned theories guided the researcher in producing the conceptual framework of the study. The conceptual framework of the study focused on the production of *tinapang lawlaw-kangkong siomai* utilizing *tinapa* and *kangkong* as raw materials.

The proponent first had to conceptualize the product to be innovated and then gathered raw materials such as *tinapa, kangkong* leaves, and the other minor ingredients in making the product. The tools and materials needed in the development of *tinapang lawlaw-kangkong siomai* also had to be carefully planned. Production of the innovative product required three (3) formulations with different proportions of *tinapa* and *kangkong* leaves. The other ingredients had the same measurement for all the formulations. The first formulation of the output contained 125 grams of *tinapa* and 125 grams of *kangkong*. Formulation 2 had

200 grams of *tinapa* and 75 grams of *kangkong*, and formulation 3 had 100 grams of *tinapa* and 150 grams of *kangkong*.

Figure 5 summarizes the process in producing the *tinapang lawlaw-kangkong siomai*. After the production, the *siomai* was evaluated by fifteen panelists through sensory evaluation using Quantitative Descriptive Analysis

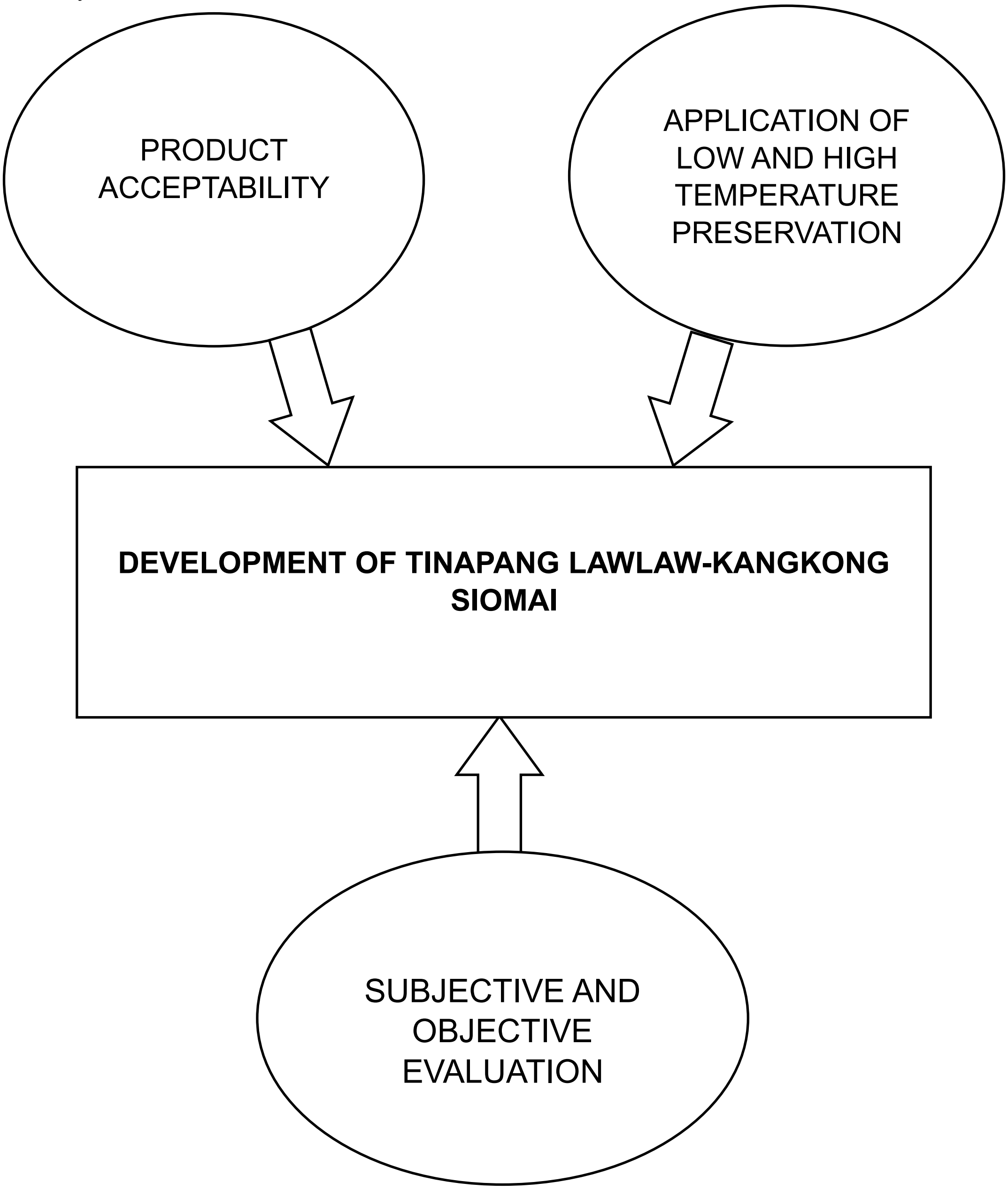


Figure 4. Theoretical Paradigm

(QDA) to determine its sensory characteristics in terms of appearance (color), aroma, taste and texture. For the level of acceptability of the product, the researcher gathered 50 selected panelists to determine the most acceptable formulation in terms of appearance (color), aroma, taste and texture.

The most acceptable formulation was used for the proximate composition analysis in terms of protein, moisture, ash, fiber, fat, carbohydrates, vitamin A and vitamin D3 contents per 100 grams. Likewise, the estimated selling price of the finished product was computed as a basis for its possible in the future.

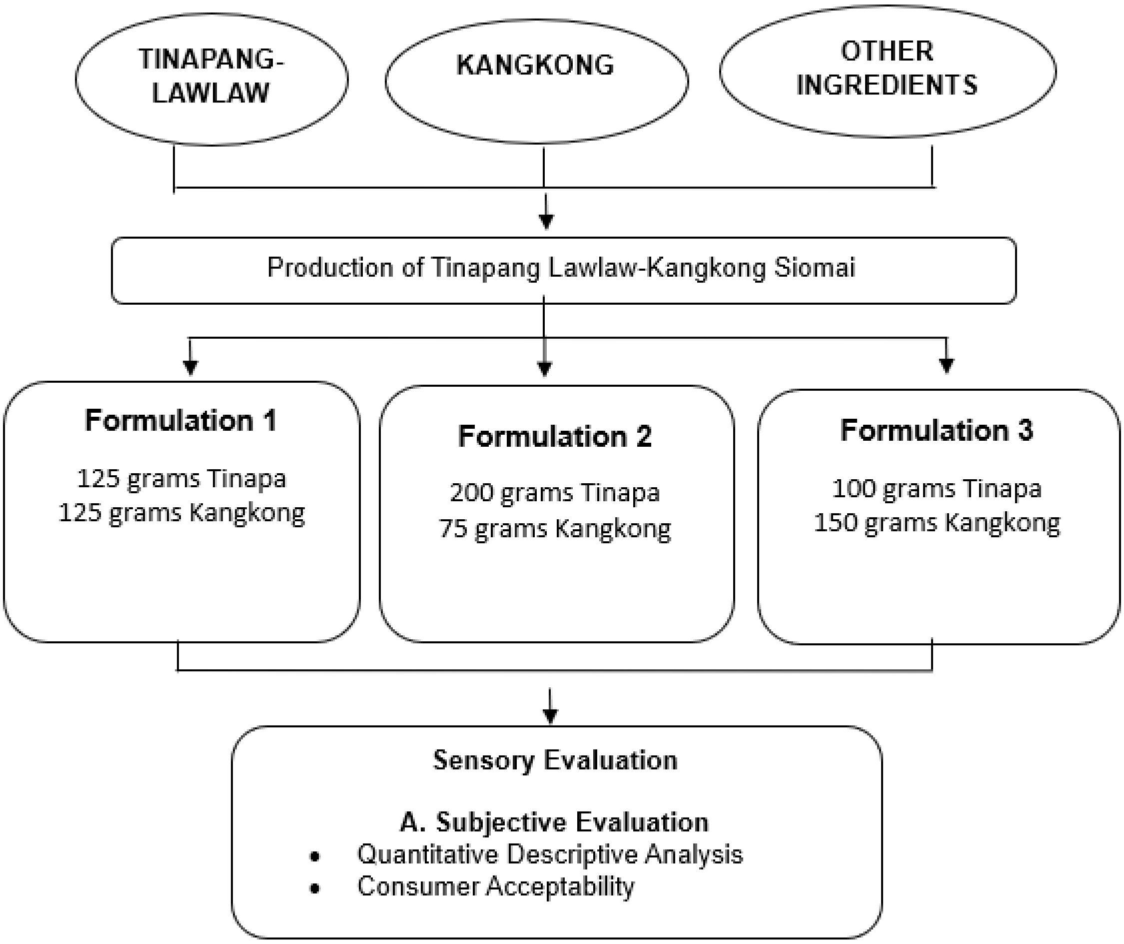
Finally, the outcome of this study was the most acceptable formulation of the *tinapang lawlaw-kangkong siomai*.

Definition of Terms

The researcher defined the used in this study for purposes of clarity. Thus, the terms were operationally and conceptually defined for clearer understanding, as used in the study.

Development and Evaluation of *Tinapang Lawlaw-Kangkong Siomai*. A newly developed *siomai* utilizing the tinapa and kangkong as raw materials in the study.

Acceptability. According to Murray and Baxter (2003), acceptability is a subjective metric based on hedonics, or pleasure, which is impacted by the food's sensory qualities. In this study, this was determined by the panelists based on how they perceived the product in general. The researcher used the 9 Hedonic Scale to identify the acceptability of the product.



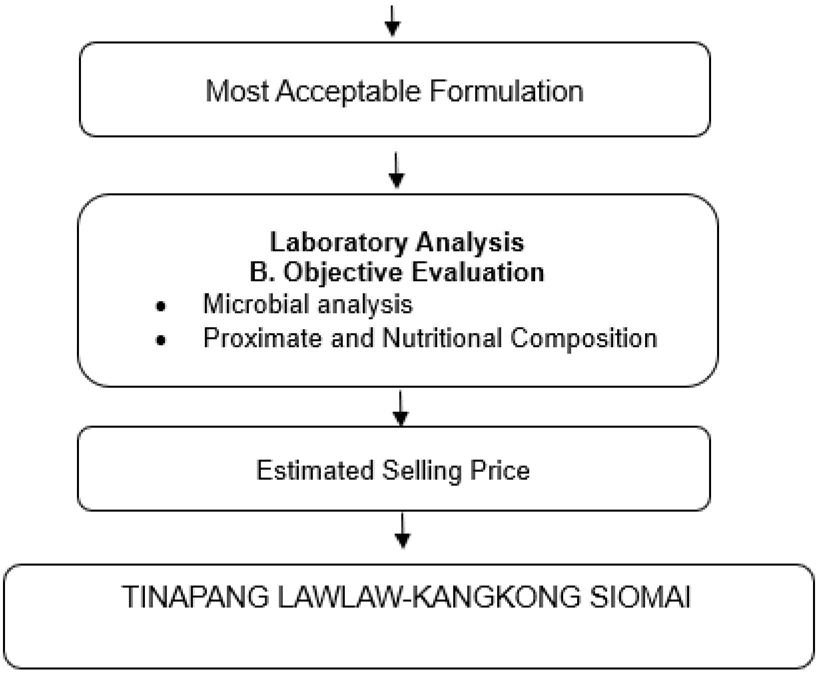


Figure 5. Conceptual Paradigm

Appearance. The way a person or thing looks or seems to other people (Cambridge University Press & Assessment, 2024). In this study, it was described as the most acceptable appearance of the Development of *tinapang lawlaw-kangkong siomai* in terms of color from light brown to dark brown.

Ash Content. The term "ash" describes the inorganic residue that is left over in a food sample following the ignition or full oxidation of organic materials (Ismail, 2017). The process involves burning a particular formulation at a high temperature to ascertain it.

Aroma. Refers to the collection of volatile compounds that give rise to the odor and aroma of the food (Bruno et al., 2021). In this study, this was the sensory characteristic of the *tinapang lawlaw-kangkong siomai*, focusing on the *tinapa* and *kangkong* aroma from weak to strong.

Calories. These are the energy that individuals use for physical activity and the energy that they obtain from the food and beverages they eat (Brazier, 2017). The term was used to quantify the level of energy found in a particular food content specifically from both *tinapang lawlaw* and *kangkong* when combined.

Carbohydrate. One of the main ways that a creature may obtain energy is through them. A mechanism is involved in converting carbohydrates into a form that cells may use as energy (Interactive Nutrition Facts Label, 2021). In the study, this was the macronutrients of healthy *siomai*.

Cholesterol. It is essential for sustaining optimal health since it facilitates the production of hormones, tissues, bile acid, vitamin D, and cellular membranes (National Cancer Institute, n.d). This was the content of *siomai* that promotes good cholesterol if healthy components are combined.

Dietary Fiber. The part of nourishment derived from plants that cannot be adequately digested by enzymes in the human body (Institute of Medicine, 2005). In this study it is the total fiber content present in the *tinapang lawlaw-kangkong siomai*.

Estimated Selling Price. This refers to the estimated based on listed price, previous sales information (Anil et al., 2008). In this study, it is total cost of producing *tinapang lawlaw-kangkong siomai*.

Evaluation. It is a method used to ensure consumer acceptability and market success for food (Ángel, 2019). This study used human senses to judge and evaluate the quality of foods and materials; it included Quantitative Descriptive Analysis and it used subjective and objective evaluation.

Fat Content. This refers to the detection method using gas chromatography to determine the triglyceride content in oil samples (Yang et al., 2016). In this study, it denotes the total fat content, encompassing saturated fats, saturated fats, unsaturated fats, and trans fats in Siomai.

Formulation. Formulation encompasses the skills and processes involved in developing and manufacturing a commercial product with specific value and meeting predetermined requirements (Simonen, 2013). In this study, this is used to refer to the specific recipe or composition of ingredients used to create a new product of siomai.

Kangkong. According to Worldcrops for Northern United States, Water spinach is an herbaceous aquatic or semi-aquatic perennial plant of the tropics and subtropics. It has a creeping growth habit but may grow erect in water. In the study, it used as one of the main ingredients that is composed of high nutrients needed in the development.

Moisture Content. According to Collins (2024) it is water or other liquid diffused as vapor or condensed on or in objects. In this study it is a crucial factor in food science since it impacts the shelf life, quality, and flavor of *siomai* products.

Other ingredients. According to Merriam-Webster Dictionary (2024), these refer to additional raw materials or products combined or included in the mixture. In this study, these are the minor ingredients, such as but not limited to oil, onions, carrot, and the like used to make the *siomai.*

Protein Content. Protein is found throughout the body—in muscle, bone, skin, hair, and virtually every other body part or tissue (National Academies of Medicine, n.d). Often quantified as a percentage of the total product weight and is an important nutritional factor.

Quantitative Descriptive Analysis (Qda). According to Gatchalian M (1989), it is a relatively young, sensory evaluation approach in the mid-seventies and has the versatility of use for the description of various product attributes. In the study, it was used to product development, quality control, and product improvement of the *siomai* development.

Sensory Characteristic. Play a crucial role in determining the acceptance and quality of food products. Research on various food items like instant porridge for the elderly (Toto et al., 2022). Certain characteristics of the *siomai* are observable by one or more human senses – Appearance, Aroma, Taste, and Texture. These characteristics aid in recognizing, assessing, and evaluating various aspects of the product.

Siomai. Is a steamed product made from minced shrimp or fish and vegetables wrapped in a dumpling wrapper and served with peanut sauce (Dico et al., 2022) The main product of the study utilizing *tinapang lawlaw* and *kangkong* as the main ingredients.

Taste. The sensation of taste commences as watery substances trigger the taste receptors situated in the mouth. Taste receptors are found in small, goblet-shaped structures known as taste buds, which can hold up to a dozen or more receptors (Pritchard,2018). Whereby, in the study, this was one of the sensory evaluations that was conducted to determine whether the development agrees with the standard of market and consumer.

Tinapa. *Tinapa* refers to the process of preserving or cooking fish by smoking it with firewood (Meniano, 2023). The researcher used *tinapa* in this study.

Tinapa Lawlaw. The *sardinella lemuru*, or locally known as *lawlaw*, is endemic in the coastal waters of Bicol and Samar (Oceana Philippines, n.d.). In the study, it is one of the main ingredients of *siomai*, and it is considered an alternative meat to be used in the production of healthy *siomai*.

Texture. The characteristics of food that can be perceived through tactile sensations in the mouth and when handled with the hands (UOF,2023). In the study, this was the accepted texture of *siomai* that may contribute to the swallowing properties of panelists.

Chapter 3
RESEARCH DESIGN AND METHODOLOGY

This chapter discusses the research design and methodology employed in this study. Likewise included are the research instrument, panelists, sources of data, and statistical treatment used in evaluating the acceptability of the product.

Methodology

The study used the descriptive type or more specifically the experimental and developmental methods of research. The researcher intentionally created external variations in the intervention allocation to facilitate the establishment of a causal relationship in the research design. Usually, experimental techniques involve the randomization of interventions or programs directly. It determined the best possible *tinapa* and *kangkong* proportions that can be added to produce an enriched *siomai*.

Blackstad (2018) stated that the use of the experimental method can provide a methodical and scientific means for conducting research, wherein the researcher intentionally alters certain variables while simultaneously regulating and observing the effects of any modifications made to other variables. When performing an experimental study, the usual approach involves manipulating a particular factor, which is referred to as the independent variable, that has an impact on the experimental group.

According to Seels & Richey (1994), in contrast to basic instructional development, the developmental approach to research refers to a structured investigation of crafting, creating, and assessing instructional programs, procedures, and goods that are required to adhere to standards of internal coherence and efficiency. To enhance the current product and identify the most favored ratio of *tinapang lawlaw-kangkong siomai*, the investigation implemented a developmental technique.

In this study, there were two sets of evaluations. First, the subjective evaluation, which included the sensory characterization of the *developed tinapang lawlaw-kangkong siomai* through these sensory attributes: appearance, aroma, taste, and texture. Quantitative Descriptive Analysis (QDA) was used to characterize the perceived sensory attributes of the product. The researcher also used a 9-point Hedonic Scaling to determine the level of acceptability of the most acceptable formulation of the *tinapang lawlaw-kangkong siomai.* Second, the objective evaluation covered the microbial load in terms of *Escherichia coli* and *Salmonella* Count. The proximate and nutritional compositions were also part of the objective evaluation, including protein, moisture, ash, fiber, fats, carbohydrates, vitamin A, and vitamin D3, as analyzed by an authorized laboratory or agency. These are the respective test methods used for the nutritional composition, such as air oven drying, ignition gravimetry, Soxhlet extraction, Kjeldahl, HPLC, Saponification/Solvent Extraction/HPLC, and Weende Method. Similarly, the cost of the most acceptable formulation was assessed to determine the estimated selling price for *tinapang lawlaw-kangkong siomai* future market potential.

Sources of Data

There were two sources of data considered in this study – primary and secondary. The primary data were obtained from the two types of sensory evaluation which were the Quantitative Descriptive Analysis and the result from consumers' acceptability test to determine the level of acceptability of the most acceptable formulation of the *tinapang lawlaw-kangkong siomai* using the 9-point Hedonic Scaling. Moreover, laboratory test results of proximate and nutritional compositions were also part of the primary sources of data for the study.

For the secondary source of data, the researcher obtained from books, unpublished master's and undergraduate theses, journals, magazines, and the internet.

Respondents of the Study

Research panelists were those who agreed to participate in the study by answering questionnaires. They assisted the researcher in gathering data for the study. There were 15 purposively selected panelists to evaluate the product for the Quantitative Descriptive Analysis (QDA) for the sensory evaluation test. The panelists were a combination of BTVTED students and Faculty from Bicol University College of Industrial Technology who were trained panelists and had knowledge and experience in sensory evaluation.

For the level of acceptability of the product, the researcher gathered 50 selected panelists, to determine if the most acceptable formulation was liked or disliked by the food consumer. This was done through stratified random sampling where both groups were divided to perform sub-groups. With that, a simple random sampling was employed to randomly select significant panelists to take in the experimental study. The researcher utilized the 9-point Hedonic Scale to correspond to a different level of acceptance. This was utilized since the level of like or dislike expressed by the panelists towards something is denoted. The general idea of the hedonic scale is that people's opinions fall on a spectrum and can be classified as either positive or negative.

Research Instrument

Several measures were implemented to ensure an unbiased outcome of the study with minimal margins of error. The initial step involved ensuring the accuracy of the instrument in evaluating the intended parameter. The consistency of interpretation for the instrument highlighted its reliability. Since there is an available questionnaire online relative to the study, this was utilized and distributed among the selected panelists.

The first part of the instrument contains the profile of the panelists followed by three (3) types of score sheets that were used in the study. The researcher used Quantitative Descriptive Analysis (QDA) in evaluating the *tinapang lawlaw-kangkong siomai*. According to (Gatchalian & Brannan, 2011), Quantitative Descriptive Analysis relies on the ability of a panelist to provide reliable data through repeated measures, a characteristic that was not used in the original flavor profile and texture profile methods. The panelists used a 6-inch line scale with word anchors (e.g. weak and strong) ½ inch from both ends for low and high intensity. A rating score for the formulation was indicated on the line scale by a vertical mark. The sensory qualities of each formulation were rated by the evaluators by inserting vertical lines with the corresponding formulation code in every horizontal line for each parameter. The result of this described and compared every formulation of the *tinapang lawlaw-kangkong siomai*.

For the level of acceptability of the *tinapang lawlaw-kangkong siomai*, the researcher used the most widely used scale for measuring food acceptability, the 9-point Hedonic Scaling. The scale is composed of (9) Like Extremely, (8) Like Very Much, (7) Like Moderately, (6) Like Slightly, (5) Neither Like Nor Dislike, (4) Dislike Slightly, (3) Dislike Moderately, (2) Dislike Very Much and (1) Dislike Extremely. Each of the nine Hedonic Scale corresponds to a different level of acceptance.

Data Gathering Procedure

In the process of gathering data needed for the study, the researcher conducted three (3) major activities, The Preparatory Phase, the Developmental Phase, and the Evaluation Phase.

1. Preparatory Phase

In the initial stage of the project, the researcher devoted attention to careful planning and thorough gathering of all essential materials and equipment required for the study. The materials and other important things were identified before the development of the product. Then the needed raw materials to be added in the development of the *tinapang lawlaw-kangkong siomai*, such as the good quality of *tinapang lawlaw*, mature *kangkong* other ingredients, like carrot, onion, garlic, all-purpose flour, cornstarch, sesame oil and egg were purchased. Optimum *tinapa* should possess a golden color or a yellowish tint (Flick, 2010). To prepare, the *tinapa,* it was washed, de-boned, flaked and ground. Hulshof et al. (1997) indicated that the provitamin A carotenoid content is significantly higher in dark green (mature) leaves compared to young leaves. This suggests that mature *kangkong* leaves may contain higher levels of provitamin A carotenoids, which are important nutrients for human health.

In this phase, the researcher carried out various tasks and conducted additional culinary experiments with a range of raw materials and formulations. The researcher singled out three optimal examples from the outcomes to exhibit to the chosen participants. The various formulations consisted of varying proportions of *tinapa* and *kangkong*, while the remaining ingredients were uniformly incorporated in all formulations.

2. Developmental Phase

In this phase, the formulation of *tinapang lawlaw-kangkong siomai* was tested through the creation of three formulations to identify the most acceptable formulation.

The first formulation consisted of 125 grams of *tinapa* and 125 grams of *kangkong*. Formulation 2 comprised 200 grams of Tinapa and 75 grams of Kangkong; while, formulation 3 contained 100 grams of Tinapa and 150 grams of Kangkong. The ingredients—sesame oil, onion, garlic, carrot, egg, cornstarch, and all-purpose flour—were consistently mixed into each formulation.

Table 5 presents the formulation of the raw materials and other ingredients used in the processing of the *tinapang lawlaw-kangkong siomai*.

Table 5

Formulation of the Ingredients

Ingredient	Formulation 1	Formulation 2	Formulation 3
Tinapa	125 grams	200 grams	100 grams
Kangkong	125 grams	75 grams	150 grams
Carrot	50 grams	50 grams	50 grams
Onion	30 grams	30 grams	30 grams
Garlic	20 grams	20 grams	20 grams
All Purpose Flour	5 grams	5 grams	5 grams
Cornstarch	20 grams	20 grams	20 grams
Sesame Oil	1.23 ml	1.23 ml	1.23 ml
Egg	1 piece	1 piece	1 piece

Source: Fish Siomai Recipe. https://www.scribd.com/document/422750655/Fish-Siomai-Recipe

The systematic procedure for preparing *tinapa* commenced with sizeable cleaning portions of Tinapa. The process involved washing and removing bones with the aid of single-use plastic gloves, followed by flaking and grinding.

The researcher chose fresh and appropriately mature *kangkong* leaves for preparation. It is important to clean fresh vegetables thoroughly by washing and rubbing them gently in a bowl of clean water to get rid of any possible surface dirt or germs to prevent cross-contamination.

The *kangkong* underwent several procedures before it was used. The researcher selected a variety of freshly harvested dark green *kangkong*. The *kangkong* was carefully handled by the researcher after washing. The cleaned kangkong was properly sliced into smaller pieces to fit the grinder.

Once the tinapa, kangkong and other ingredients such as carrot, onion, garlic, all-purpose flour, cornstarch, sesame oil and egg were ready; the researcher weighed each set of ingredients for the three (3) formulations, mixed each proportion, weighed, wrapped, shaped into *siomai* and steamed, after steaming the product, it was placed in a microwaveable container for cooling. The formulations of *tinapang lawlaw-kangkong siomai* were properly stored in a container for freezing and for easy handling during cooking. These were also labelled and sealed in a microwaveable container.

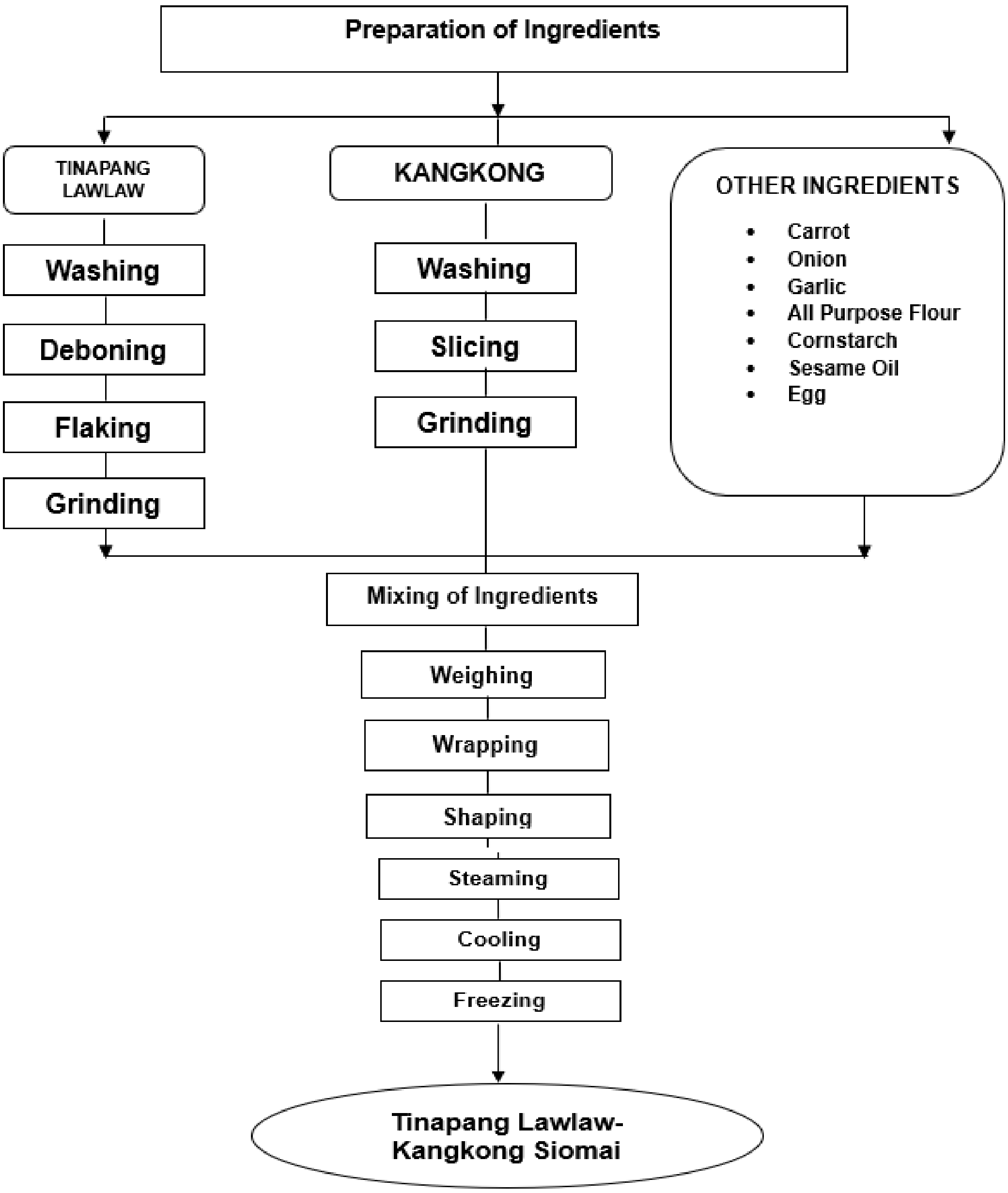


Figure 6 ***Process Flow Chart of Tinapang Lawlaw-Kangkong Siomai Preparation***

3. Evaluation Phase

This phase consists of two kinds of evaluation: (a) subjective and (b) objective evaluation. The subjective evaluation included sensory evaluation from the result of the opinion of the selected panelists, observed by the sense of sight, smell, taste, and touch. The objective evaluation included a laboratory analysis test for the nutritional composition of *tinapang lawlaw-kangkong siomai.*

For the subjective evaluation, the researcher performed the sensory evaluation of the three (3) formulations of *tinapang lawlaw-kangkong siomai* for the sensory characteristics quality in terms of appearance, aroma, texture, and taste using the Quantitative Descriptive Analysis (QDA). The researcher used a 9-point Hedonic Scaling to determine the level of acceptability of the most acceptable formulation of *tinapang lawlaw-kangkong siomai*.

For the evaluation phase, the panelists were given an invitation letter, and they were gathered in one room, specifically in the Food Technology building. They were given three coded formulations of fried *siomai* and two kinds of score sheets were provided. The researcher gathered 15 purposively selected trained panelists who were BTVTED students and faculty from Bicol University College of Industrial Technology. They have knowledge and experience in sensory evaluation. The study used (QDA) Quantitative Descriptive Analysis and Consumers Acceptability Score Sheet for the most acceptable formulation of the product. For the quantitative descriptive analysis, the respondents evaluated the product with the determined sensory quality attributes of the products in terms of its appearance, aroma, taste, and texture. The score sheet consisted of 6-inch, unscaled horizontal line for appearance, aroma, taste, and texture. The horizontal line consists of the identified characteristics of the product based on the appearance (color), aroma (tinapa) aroma (kangkong), taste (tinapa) taste (kangkong) and lastly the texture of the *siomai*. During the evaluation of the three formulations, each panelist was provided three formulations of different proportions of *tinapa* and *kangkong* and the same proportion of other ingredients. The three formulations were evaluated for intensity based on their quality attributes. The panelists rated the intensity of each attribute by marking a vertical line across the appropriate horizontal line. These marks are converted to numerical data by measuring the distance from the origin of the line to the vertical line. For the evaluation of the consumer's acceptability, the researcher gathered 50 incidentally selected panelists who evaluated using the 9-point hedonic scale to determine if the formulation is accepted by the food consumers. The panelists found comfortable seats and they were given a bottle of water. Then, the evaluators started the evaluation. After the evaluation, the two kinds of score sheets were immediately retrieved by the researcher to start gathering the data for additional analysis and interpretation.

The second was the laboratory analysis of the proximate and nutritional compositions content of the *tinapang lawlaw-kangkong siomai* in terms of protein, moisture, ash, fiber, fats, carbohydrates, vitamin A, and vitamin D3. These were done in The First Analytical Services and Technical Cooperative (F.A.S.T Laboratories) Cubao, Quezon City.

Statistical Tool

To facilitate the analysis and interpretation, the data obtained using the process flow chart of the procedure were statistically treated using arithmetic means.

The sample groups underwent descriptive statistical analysis. The aim was to acquire an impartial paper without any cost. To accomplish this task, one used statistical analysis. The information was categorized and visualized through charts and graphs, in addition to being systematized and encoded for usage in the statistical analysis for social sciences. Using a chi-square test established the relationship between environmental sanitation concerns and their effect indicators. The level of statistical significance previously determined is $p<0.05$.

The ratio of the value's sum over its number is what is referred to as the arithmetic mean, or average. It was then utilized to get the average scores for the three example goods' specified qualities.

Mathematically, it is written as:

$$X = \frac{X_1+X_2+X_3+Xn...}{N}$$

Where:

X= Arithmetic mean

ΣX = Sum of X

$X_1+X_2+X_3+Xn...$ = Represent the value of X

N = Number of Panelists

Source: Bauer. (2010). Calculations Using Symbols. doi: 10.1007/978-3-642-02992-9_3

Weighted mean is the ratio of summation of the product of the individual over the summation. It was used to determine the ranking of the products to the degree of preference.

$$\overline{X} = \frac{fx}{N}$$

Source: Corporate Finance Institute, n.d. Weighted Mean. https://corporatefinanceinstitute.com/resources/data-science/weighted-mean/

Where:

$\overline{X}$ = Weight mean

fx = Average of all products of frequency (f) and weight (x)

N = Number of panelists

Percentage, a fraction of a whole number expressed in hundredths. It is usually represented by the symbol %.

$$P = \frac{f}{n} x100$$

Where:

P = Percentage

f = frequency

n = Total number of panelists

Source: Mandal (2023) Percentage | Formula & Calculation. https://study.com/academy/lesson/calculate-percentages-formula-lesson-quiz.html#:~:text=Percentage%25=(nx/ntotal),a%20bag%20containing%20100%20balls.*

Chapter 4

DEVELOPMENT AND EVALUATION OF TINAPANG LAWLAW (*Sardinella lemuru*)-KANGKONG (*Ipomoea aquatica*) SIOMAI

This chapter presents the discussion of the development and evaluation of *tinapang lawlaw-kangkong siomai* and the interpretation gathered to answer the problems posed in this study to find out the microbial load of the three (3) formulations for *tinapang lawlaw-kangkong siomai* in terms of *Escherichia coli* Count and *Salmonella* Count. The sensory characteristics of the three formulations of *tinapang lawlaw-kangkong siomai* in terms of appearance, aroma, texture, and taste. This also includes the result of the laboratory analysis regarding its proximate and nutritional compositions and the estimated selling price of Siomai production.

Microbial load of the three (3) formulations for Tinapang Lawlaw-Kangkong Siomai

The three (3) formulations of *tinapang lawlaw-kangkong siomai* were subjected to microbial analysis in terms of *Escherichia coli* and *Salmonella* count. It was done to ensure that the product is safe for consumption, has acquired a tolerable *Escherichia coli* count, and is free from *Salmonella*.

The *Escherichia coli* bacteria species are many and diverse, according to the Centers for Disease Control and Prevention. Certain *Escherichia coli* bacterial strains are harmless, but others can be harmful. While certain *Escherichia coli* strains might cause diarrhea, others can cause pneumonia, lung conditions, UTIs, and other illnesses. Different varieties of *Escherichia coli* are a sign of water contamination, which is why you may have heard about *Escherichia coli*. The presence of *Escherichia coli* in drinking water, while not dangerous in and of itself, is a sign that the water is tainted. Even microbiologists find it quite perplexing at times.

Using polyvalent antisera against somatic O antigens, an agglutination test may be used to determine the serogroup of *Salmonella*. Then, using tube agglutination tests with antisera to flagella H antigens and slide agglutination tests with monovalent antisera to certain O antigens, one may define the specific serovar (Gast et al., 2020).

About 100,000 human cases of salmonellosis are thought to be caused by the foodborne bacterium *Salmonella* each year in the European Union (EU), according to Jordan (2018). *Salmonella* species. has been removed from a variety of substances, such as water, soil, surfaces that come into touch with food, raw meats, poultry, fresh fruit, nuts, and seeds, as well as baby formula. Meat and poultry, eggs, chocolate, smoked salmon, baby formula, peanut butter, and fresh fruit are among the items linked to salmonellosis.

The microbiological analysis of food is part of food safety management and conformity tests that define microbiological criteria or assess the performance of control strategies based on the Hazard Analysis and Critical Control Point.

A rapid method can be defined as any method or system that reduces the time required for obtaining a microbiological test result (Feng, 1996). These include enumeration methods (quantitative methods) and detection methods (qualitative methods), which can be used depending on the objective of the study.

FDA Circular No. 2022-012 described the food to which a criterion applies, the required tests or the microorganisms considered acceptable, marginally accepted, or critical, and the number of formulations that should conform to the limits. The results for the *Salmonella* in the Tinapang Lawlaw-Kangkong Siomai product were not detected in a 25-gram formulation, and the test was conducted by the Department of Science and Technology.

Table 6 shows the result of the microbial load of Tinapang Lawlaw-Kangkong Siomai is <10 CFU*/g for *E. coli* Count, the analysis was conducted by the Department of Science and Technology, Rawis Legazpi

City. The results for microbial load of the *Escherichia coli* Count and *Salmonella* Detection in Siomai were within the safe and allowable limit. This suggests hygiene and food safety procedures were applied during the preparation of the Tinapang Lawlaw-Kangkong Siomai. This suggests that using the aforementioned product is safe as well.

Table 6

Results of Microbial load of the three (3) formulations for Tinapang Lawlaw-Kangkong Siomai

Sample and Laboratory Code	E. coli Count	Salmonella Detection in Food
Formulation 1	<10 CFU*/g	Not Detected in 25 g sample
Formulation 2	<10 CFU*/g	Not Detected in 25 g sample
Formulation 3	<10 CFU*/g	Not Detected in 25 g sample

Sensory Characteristics of the Three Formulations of Tinapang Lawlaw-Kangkong Siomai

The selection of ingredients in the making of Soimai Tinapang Lawlaw, significantly influences its overall qualities and sensory attributes. Tinapa, which is smoked fish, significantly enhances the flavor profile of the product, Smoke contains aromatic substances enhancing color, taste, and smell. (Belichovska, 2019).

The Sensory Characteristics of the three (3) Formulations of Tinapang Lawlaw-Kangkong Siomai were evaluated using the Quantitative Descriptive Analysis (QDA) in terms of appearance (color), aroma (tinapa aroma and kangkong aroma); texture; taste (tinapa taste and kangkong taste) and saltiness. The panelists evaluated the formulations given and answered each question by placing a vertical line across the 6-inch horizontal line of the point that best describes the property of the formulation to gather the data needed in the conduct of the study. The result for this evaluation was computed using the arithmetic mean, where the total number of responses was divided by the total number of panelists per sensory attribute and interpreted based on the legend per parameter presented in the table below. It provides a comprehensive analysis of the sensory characteristics of *tinapang lawlaw-kangkong siomai*, a type of Filipino steamed dumpling.

Table 7 shows the results of sensory evaluation on the sensory characteristics of tinapang lawlaw-kangkong siomai using Quantitative Descriptive Analysis (QDA) in terms of appearance (color), aroma (*tinapa* and *kangkong*), texture, taste (*tinapa* and *kangkong*), and saltiness.

Table 7

Sensory Characteristics of Tinapang Lawlaw-Kangkong Siomai

Sensory Attributes	Formulation 1		Formulation 2		Formulation 3	
	Mean	Description	Mean	Description	Mean	Description
Appearance (Color)	3.41	Brown	2.36	Brown	1.75	Light Brown

Tinapa Aroma	3.71	Moderate	3.77	Moderate	2.04	Moderate
Kangkong Aroma	1.91	Weak	1.65	Weak	3.40	Moderate
Texture	2.26	Firm	3	Firm	2.40	Firm
Tinapa Taste	2.94	Pronounced	4.51	Very Pronounced	1.51	Less Pronounced
Kangkong Taste	2.48	Pronounced	1.30	Less Pronounced	4.05	Very Pronounced
Saltiness	2.5	Salty	3.40	Salty	1.23	Less Salty

Legend:
Color: 0-1.9 Light brown; 2.0-3.9 Brown; 4.0-6.0 Dark brown
Aroma: 0-1.9 Weak; 2.0-3.9 Moderate; 4.0-6.0 Strong
Texture: 0-1.9 Less firm; 2.0-3.9 Firm; 4.0-6.0 Very firm
Taste: 0-1.9 Less pronounced; 2.0-3.9 Pronounced; 4.0-6.0 Very pronounced
Saltiness: 0-1.9 Less Salty; 2.0-3.9 Salty; 4.0-6.0 Very Salty

In terms of appearance, Formulation 3 has a light brown color (1.75) compared to Formulation 1 (3.41) and Formulation 2 (2.36), which suggests that the amount of *tinapa* and *kangkong* may have affected the color of the siomai. Ogbadu (2014) cited that smoked foods result from long-standing traditional preservation methods, prized by consumers for the rich flavor and aroma imparted by wood smoke produced during combustion, which is also used to flavor foods. Making a more browning of formulations 1 and 2 indicating a more tinapa content as compared to formulation 3.

For the aroma, the researcher has smelled the tinapa aroma and kangkong being the main ingredients in the *siomai*. The *tinapa* aroma was more detected in formulation 2 with 200 grams of *tinapa* and 75 grams of *kangkong* while the formulation 1 has 125 grams *tinapa* and 125 grams *kangkong*; and formulation 3 with 100 grams *tinapa* and 150 grams *kangkong* got a weak aroma, which means that the combination of *tinapa* and *kangkong* lessens the strong aroma of *tinapa* that is why the result is weak. The evident *tinapa* and *kangkong* aroma in the formulations indicate that the proportion for each formulation can also impact the taste of the food.

For the texture, the various formulation of *tinapa* and *kangkong* with other ingredients, resulted in firmed texture, which means that the mixture can be formed or shaped into *siomai*, comparable to the existing *siomai* in the market. According to Carcelli et al., (2020) flour and cornstarch serve as thickening agents rather than taste enhancers, implying that their impact is more nuanced. Nevertheless, their presence could have influenced the consistency of the siomai, resulting in a more gelatinous or sticky sense.

In terms of taste, and based on the results, formulation 1 has pronounced taste, formulation 2 has very pronounced taste, and formulation 3 has less pronounced taste which means that the strong taste of *tinapa* when combined to kangkong, the taste of *tinapa* was affected; hence, it becomes very or less pronounced, but it can still be detected in the *siomai* product. Abdul et al., (2020) state that hot smoking improves taste by enhancing sensory attributes of fish and smoking suppresses off-flavors and enhances overall preferences of product.

The sensory characteristics of each sample in terms of saltiness showed that formulation 1 had a mean score of 2.5 (salty), formulation 2 had a mean score of 3.4 (salty), and formulation 3 had a mean score of

1.23 (less salty). According to Nathalie & Lekahena (2020), salt concentration affects saltiness in smoked fish products. The results indicated that the equal proportion of tinapa and kangkong, combined with other ingredients, created a balanced taste.

The sensory evaluation showed that formulation 1 and formulation 2 were both salty compared to formulation 3, which was less salty. The equal quantity of the other ingredients in all three formulations suggests that the saltiness of formulations 1 and 2 was influenced by the amount of Tinapa present.

Results revealed that the formulations from different variation of formulations exhibit distinct differences in their sensory attributes. In terms of appearance, Formulation 3 has a light brown color (1.75) compared to Formulation 1 (3.41) and Formulation 2 (2.36), which suggests that the amount of *tinapa* and kangkong may have affected the color of the *siomai*. It was noteworthy that the brown color of the three formulations was due to the smoking process in *tinapang lawlaw*. However, the brown color became more evident in formulations 1 and 2. It was observed by the researcher that formulation 1 with an equal proportion of *tinapa* and *kangkong* developed a more dominant brown color.

Ogbadu (2014) cited that smoked foods result from long-standing traditional preservation methods, prized by consumers for the rich flavor and aroma imparted by wood smoke produced during combustion. These foods are preserved through a combination of complementary techniques. Wood smoke contains various organic chemical compounds, some with known antimicrobial properties. When condensed into water, wood smoke produces liquid smoke, which is also used to flavor foods. Making a more browning of formulations 1 and 2 indicating a more tinapa content as compared to formulation 3.

The *tinapa* aroma is consistently moderate across all formulations, indicating a consistent level of smokiness in the filling. However, the *kangkong* aroma shows significant variations, with Formulation 1 having a weak aroma and Formulation 3 having a moderate one. As cited by Ogbadu (2014), when wood smoke was condensed into water, wood smoke produces liquid smoke, which is also used to flavor foods. It can be implied that the *tinapa* flavors were retained in the three formulations due to the presence of the liquid smoke. However, the smoke flavor lessens as the *tinapa* content decreases and *kangkong* component increases.

According to Nurhidayati et al. (2023), *kangkong* (Ipomoea reptans pair) is rich in chlorophyll. The key pigments for photosynthesis, the essential mechanism by which plants produce energy, are chlorophyll molecules, which are magnesium-tetrapyrrole pigments that give plants their characteristic green hue (Nelson (n.d.), also mentioned that when sodium and copper are added to chlorophyll, the pigment becomes water-soluble and is known as chlorophyllin. Chlorophyllin has been used to cleanse and speed up the healing of open wounds, reduce inflammation in radiation burns, and decrease odor. It can be implied that the deodorizing capacity of chlorophyll in green kangkong had caused the decrease in the smoke odor in the formulation 3 which have the highest composition of kangkong and lowest content of tinapa.

The texture of the *siomai* is generally firm across all formulations, with no differences. It all resulted as firm. The presence of 20g cornstarch and 5g of all-purpose flour in all formulation were not affected by the various components of *tinapa* and *kangkong*. Fincher (2020) cited that cornstarch is mainly used as a thickening agent. It consists of long chains of starch molecules that unravel and swell when heated with moisture. This process, known as gelatinization, is what causes the thickening effect. On the other hand, Bakerpedia (2024) stated that all-purpose flour is a versatile wheat flour used for general purposes. It is milled from hard red wheat or a blend of hard and soft wheats, typically in an 80:20 ratio. As its name implies, all-purpose flour is suitable for a wide range of baked goods, including bread, biscuits, pizza, cookies, muffins, and more. “It can also be used as a thickening agent in soups and stews” (Alfaro 2023). The taste of the *tinapa* varies significantly among formulations, with formulation 2 containing 200g *tinapa* described as having a very pronounced taste and formulation 3 with 100g *tinapa* is said to have a less pronounced one. Colinares (2007) cited that smoked fish, or Tinapa, is a Filipino delicacy prepared by cooking and preserving fish through smoking. The process involves two stages: brining, which imparts a savory taste and keeps the fish moist, and smoking, which cooks the fish and infuses it with a smoky flavor. It can be implied that formulation 2 having 200g *tinapa* infuses more savory taste and smoky flavor than formulation 3 containing only 100g *tinapa*. In the same manner, incorporating *tinapa* in different products have the same effect since wood smoke produces liquid smoke causing the smoky flavor of food according to Ogbadu (2014).

The *kangkong* taste also exhibited variations, wherein formulation 2 with 200 grams *tinapa* and 75 grams *kangkong* has a less pronounced taste and formulation 3 with 100grams tinapa and 150 grams *kangkong* has a very pronounced one. Paras (2021) mentioned that *kangkong* is a leafy green vegetable commonly used in various East and Southeast Asian cuisines. Similar to spinach or watercress, it is a versatile ingredient often featured in stir-fries or served as a side dish alongside hearty, meaty meals. The mild flavor of kangkong can be enhanced with different marinades. It can be implied that the *kangkong* in formulation 3 which has the 100 grams *tinapa* enhances the flavor of the 150 grams of kangkong more than in formulation 2 which contains more *tinapa* (200g) but lesser amount of kangkong (75g).

Finally, the saltiness of the *siomai* also shows some differences, with formulation 2 having 200g of *tinapa* being the saltiest and formulation 3 having 100g *tinapa* being the least salty. Since *tinapa* is already salty, it means that more *tinapa* added to food can result in its high saltiness. The saltiness of the *tinapa* is due to the added salt during cooking. Afterall, smoked fish is a product made from whole or filleted fish that has been cured and/or cooked with salt and then exposed to smoke produced by burning wood or other smoking materials (Zalameda, n.d.).

The findings in Table 7 have important implications for the production and marketing of *tinapang lawlaw-kangkong siomai*. The results indicated considerable variation in the ingredients used in different formulations, causing noticeable differences in the sensory attributes of the product. Customers have distinct preferences for appearance, aroma, texture, taste, and saltiness, which varied among individuals based on personal tastes (Tournier, 2007). This also means that consumers possess unique preferences and expectations regarding these sensory attributes. For example, consumers of formulation 1 preferred a deeper shade of brown and a more intense kangkong aroma, whereas those of formulation 2 favored a lighter shade of brown and a more distinct *tinapa* flavor.

Siomai manufacturers and producers should consider these variations when developing their products to meet the diverse tastes and preferences of consumers. Furthermore, the outcomes of the sensory evaluation emphasized the importance of implementing quality control in the production process to ensure consistency in the sensory attributes of *siomai*.

The Level of Acceptability of the *tinapang lawlaw-kangkong siomai*

When developing a new product, researchers must consider several aspects, including pricing, packaging, and convenience, that affect consumer acceptance. However, one factor—the sensory evaluation—deserves careful consideration. The product's sensory qualities were ascertained through sensory evaluation, and the researcher used the 9-point Hedonic Scale to assess the degree of acceptability for appearance, texture, taste, and overall acceptability.

Table 8 on the following page shows the level of acceptability, in which the researcher used arithmetic mean, of the *tinapang lawlaw-kangkong siomai.*

Appearance of the *tinapang lawlaw-kangkong siomai* in terms of color, which may vary from light brown to dark brown. Appearance is the visual aspect, color, shape of the product (Petjon et al.,2023). The three most significant appearance factors that the panelists saw were color, size, and shape. Based on the panelists' evaluation of the appearance, formulations 1, 2, and 3 all had mean scores that were nearly identical, falling between 7.1-8.0, or *Like Very Much*.

Table 8

Level of Acceptability of the Tinapang Lawlaw-Kangkong Siomai

Attributes	FORMULATION 1		FORMULATION 2		FORMULATION 3	
	Mean	Description	Mean	Description	Mean	Description
Appearance	8.04	Like very much	7.84	Like very much	7.72	Like very much
Aroma	7.78	Like very much	7.62	Like very much	7.5	Like very much
Taste	7.92	Like very much	6.96	Like moderately	7.64	Like very much
Texture	7.56	Like very much	7.22	Like very much	7.64	Like very much
General Acceptability	8.04	Like very much	7.06	Like moderately	7.72	Like very much

Legend: 0-1.0 Dislike extremely, 1.1-2.0 Dislike very much, 2.1-3.0 Dislike moderately, 3.1-4.0 Dislike slightly, 4.1-5.0 Neither like nor Dislike, 5.1-6.0 Like slightly, 6.1-7.0 Like moderately, 7.1-8.0 Like very much, 8.1-9.0 Like Extremely

On the aspect of liking the *siomai* appearance of light brown to dark brown, Magalhães (2024) cited that color is the most significant intrinsic sensory cue in shaping people's expectations about the taste and flavor of food and drink. In addition, people prefer foods and beverages that taste as they expect them to taste. They generally dislike surprises, especially with stimuli entering the mouth, which have the potential to be harmful.

Smell perceives the aroma or fragrance of the product (Leksrisompong et al., 2012). The pungent smell of the food gave way to the aroma of the *kangkong* and *tinapa*. The panelists evaluated the three formulations of *tinapang lawlaw-kangkong siomai* in terms of its aroma. Formulation 1 received a mean score of 7.78 from the panelists, whereas formulation 2 and formulation 3 obtained the mean scores of 7.62 and 7.5, respectively. The formulation has a mean score of 7.1-8.0, evaluated as *Like Very Much*.

In line with liking the moderate aroma of the *siomai* product, Nourry (n.d) cited that the 'good taste' label enhances the perceived intensity of the aromas, while the 'health' label is associated with a lower intensity of the aromas. From this, it may be implied that the consumers perceived the food product to have good taste as it possessed the expected aroma of the *tinapa* and *kangkong siomai*. It is on this that formulation 1 and 3 received the mean scores of 7.92 and 7.64, respectively, assessed as *Like Very Much*, whereas formulation 2 received a mean score of 6.96 and was described as *Like moderately* by the panelists.

These results mean that there is a substantial difference between each formulation and the others. For this reason, adding varying amounts of *tinapa* and *kangkong* significantly impacts the product's flavor. In this study, the respondents like the moderate aroma which equates to the moderate taste and disliked strong aroma which significantly impacted taste characterized by saltiness. According to Nunez (2020), taste is the way your taste buds' sensory cells perceive things. When food molecules stimulate these sensory cells, your brain perceives a taste, such as sweetness.

Next aspect to be evaluated was texture, or the qualities of food that can be felt with the hands and in the mouth are referred to as its texture. Food texture can be described in various ways: lumpy or smooth, mushy or crunchy, soft or hard (Dahl, 2020). Still on Table 8, data present the result of the evaluation of the panelists for the *siomai* in terms of texture. The answers of the panelists for formulation 1 had a mean score of 7.56, indicating *Like Very Much*; formulation 2 had a mean score of 7.22, also indicating *Like very much*, and formulation 3 had a mean score of 7.64, indicating *Like Very Much*.

In terms of the firmness of the *siomai* product, it is expected that it is firm, because it was pre-cooked prior to storing. If it is not pre-cooked leaving it, may make it soggy. Merano, (n.d.) cited that firm pieces of *siomai* should be placed into a freezer bag, like how pre-made *siomai* is sold in the market. This method effectively preserves the *siomai*. Once bagged, the *siomai* should be stored in the freezer, where it can last for about three months. Freezing is particularly effective for uncooked *siomai,* but keeping uncooked siomai in the refrigerator can make them soggy. Hence, it is important to pre-cook the three formulations of the siomai, containing tinapa, kangkong and thickening agents (Swarna et al., 2017) for it to retain its firm texture.

Formulations 1, 2 and 3 were rated as *Like Very Much*. Formulation 1 had the highest mean score compared to the other two formulations and was also favored in terms of appearance, aroma, and taste. The factor that made the formulation 2 (with highest content of tinapa) receive the description moderate liking from the respondents is its saltiness.

The findings indicated that there were no differences among the three formulations. As a result, all formulations and the procedures used to create the product were deemed acceptable. The panelists noted that Formulation 1 had a balanced taste of *kangkong* and *tinapa*; formulation 2 had a high *tinapa* content thus it is more salty; while, formulation 3 had a less salty taste as it had less *tinapa*. The raw materials and substitutes for *kangkong* and *tinapa* did not affect the overall acceptability of the *siomai* products.

As for the general acceptability which refers to the overall liking or approval by consumers (Leksrisompong et al., 2012), results are likewise shown in Table 9 on the next page. From the table, it is notable that almost 32% of the panelists gave the rating *Like Extremely*. 42% chose the rating *Like It Very Much* and 24% mentioned that they *Liked It Moderately*, whereas 2% were neutral or opted for *Like Slightly*. The implication of these results is that the favored formulation has a very high level of acceptability among consumers.

Table 9

Result of the Consumer's Level of Acceptability of Tinapa-Kangkong (Ipomoea Aquatica) Siomai

SCORE	OPTION	FREQUENCY	PERCENTAGE
9	Like Extremely	16	32
8	Like Very Much	21	42
7	Like Moderately	12	24
6	Like Slightly	1	2

5	Neither like or dislike	0	0
4	Dislike Slightly	0	0
3	Dislike Moderately	0	0
2	Dislike Very Much	0	0
1	Dislike Extremely	0	0

The evaluation of the *tinapang lawlaw-kangkong siomai* formulation by the panelists yielded similar results, indicating a high level of acceptability in terms of numerous sensory qualities. The average scores for appearance, aroma, and taste all fall within the description *Like Very Much*, suggesting that the panelists greatly enjoyed the formulations. With the exception of Formulation 2, all other formulations did not have any noteworthy problems. Formulation 2, however, had a lower score for taste since it contained a larger amount of *tinapa*, which made it saltier than the other formulations.

Hence, this indicated that the inclusion of *tinapa* and *kangkong* in the *siomai* products significantly contributed to their overall acceptability. The formulations' firm texture, due to the inclusion of thickening agents, significantly contributed to their overall preference. The varying quantities of *tinapa* and *kangkong* had a notable effect on the flavor of the product, as indicated by the contrasting taste scores observed among the formulations.

A notable aspect of this study was the consumers' high level of acceptability. Approximately three-quarters of the panelists (74%) scored the formulations as *Like Very Much* or *Like Extremely*, suggesting that the product possesses a significant degree of consumer appeal. This implies that the product has the potential to achieve commercial success if promoted effectively.

The sensory attributes that received high scores in Table 7, such as appearance, aroma, and texture, also correspond to the high levels of acceptability in Table 8. Specifically, the formulation with brown color (Formulation 1), moderate tinapa aroma, and firm texture (Formulations 1 and 3) received high scores for appearance, aroma, and texture, respectively. These same formulations also received high scores for general acceptability, with Formulation 1 having the highest score.

The results indicate that the sensory attributes of the product were essential in determining its level of acceptability. The combination of a pleasing appearance, aroma, and texture appears to be a pivotal determinant in influencing consumer preference. The prominent *tinapa* flavor in formulation 1, which received excellent feedback for its taste, may also have been a significant factor in its overall high level of acceptability. On the other hand, the lower taste score of formulation 2, attributed to its salty flavor, likely played a role in its decreased degree of acceptability.

The findings further showed the significance of achieving balance in the composition of the product. The well-balanced flavor profile of formulation 1, with a distinct *tinapa* taste and a subtle *kangkong* aroma, likely played a significant role in its high level of acceptance. On the other hand, the elevated *tinapa* concentration and saltier taste of formulation 2 may have led to a less satisfactory outcome.

Proximate And Nutritional Composition of Tinapang Lawlaw-Kangkong Siomai

Table 10 below shows the proximate and nutritional compositions of *tinapang lawlaw-kangkong siomai*. These food constituents may be of relevance in the food business for innovation in products, assurance of quality, or compliance with regulatory requirements. Hence, as mentioned by Ganogpichayagrai (2020) thoroughly considering the collection as well as the preparation of formulations is crucial to analyzing a uniform and comprehensive specimen and acquiring precise outcomes.

Table 10

Proximate and Nutritional Compositions of Tinapang Lawlaw-Kangkong Siomai

Parameters	**Test Method**	**Result**
Moisture - g/100g	Air Oven Drying	56.4
Ash - g/100g	Ignition Gravimetry	2.96
Fat - g/100g	Soxhlet Extraction	8.51
Protein (N x 6.25) - g/100g	Kjeldahl	11.3
Carbohydrate – g/100g		29.75
Vitamin A - g/100g	HPLC	558
Vitamin D_3 - g/100g	Saponification/Solvent Extraction/HPLC	Less than 3**
Crude Fiber - g/100g	Weendee Method	2.38

In the table, the proximate and nutritional composition of tinapang lawlaw-kangkong siomai is displayed. Firstly, the moisture content, which resulted in 56.4g, relatively high which can contribute to shorter shelf life and potential for microbial growth if non-compliance with preservation method. As mentioned by the FDA on the circular number 2007-010, the product is allowed to have a maximum of 10% moisture based on the dry weight or 10%, According to Igwenyi et al. (2011) the results of the green *kangkong* revealed a 51.36% moisture and in the study of Permadi et al. (2022), it also revealed that the moisture of lawlaw is 60%, which explains the relatively high moisture content. Furthermore, other elements impact the lifespan, freshness, along with the capacity of the food to withstand contamination from bacteria. The presence of excessive moisture in a food product can accelerate the development of microorganisms, leading to both premature spoilage and a reduced shelf life. This greatly influences the likelihood that the products attain their specified expiration date (Moore, 2020).

In terms of ash content which is 2.96g, it suggests a moderate amount of minerals in the total formulation. Compared to the standard ash content of food when tinapa is added which is 5% made the result to be moderate (De Vera,2019). According to Igwenyi et al. (2011) the results of adding the green *kangkong* revealed a 2.75% ash. Ash can serve as the initial stage in the preparation of specimens for the study of certain minerals, using techniques such as atomic spectroscopy or the classical methods, Ignition Gravimetry. The ash percentage of fresh products is typically below 5%, however, certain processed food products may possess amounts of ash that are as much as twelve percent (UMASS,n.d).

Meanwhile, the fat content garnered 8.51g, considered to be a low-moderate fat product that can contribute to the flavor, texture, and sensory appeal. According to Nathalie and Lekahena (2020) *tinapa* contains fat 7.0559-9.6603% while in the study of Igwenyi et al. (2011) the results of adding the green *kangkong* revealed a 0.81% of fat. Hence, as mentioned, 17.5g ± 2.5g per 100g serving is the standard range of fat content. The Dietary Guidelines for Americans state that individuals should obtain between 20 and 35 percent of their total daily intake of calories through fats. It is recommended to restrict the consumption of fats that are saturated to no more than ten percent of the overall calories throughout this range, and instead, substitute them with unsaturated ones, including those present in oils derived from plants, nuts, and seafood (OASH, 2024).

According to Wahyuningsih (2005), Lemuru Fish (*Sardinella*) has a high protein content (17.8-20%). Additionally, it contains important fatty acids, especially omega-3. The study by Igwenyi et al. (2011)

revealed that green *kangkong* has a 1.70% protein content. Thus, the protein content of the tinapang lawlaw-kangkong siomai is 11.3g, indicating a moderate protein formulation. The required dietary protein, according to the FDA, is 15 to 20% for fresh food and a standard of 50g for daily values (FDA, 2024). This suggests that the formulation needs to consider how many *siomai* servings are needed to meet the required protein intake or establish an added content to reach the required daily intake of protein. The British Nutrition Foundation (2024) explains that proteins play a crucial role in the process of absorbing and transporting different nutrients, such as minerals, iron, and calcium. Proteins are typically more satiating than carbohydrates and fats, resulting in a prolonged feeling of fullness after consumption. This can facilitate weight management by inhibiting excessive food consumption and encouraging a well-balanced diet.

Moreover, the study of Mutamimah and Arista (2023) explains that "chemical characteristics of *sardinella lemuru* head meal as a raw material for making processed food revealed a 24.19% of carbohydrate content and the proximate analysis on *Ipomea aquatica* the results revealed 42.18% carbohydrate (Igwenyi, 2011). Nutrients that provide energy are carbohydrates (Interactive Nutrition Facts Label, 2021). For every gram of carbs ingested, the body obtains 4 calories. The body uses carbohydrates as its primary energy source. They are quickly absorbed by the body and converted to glucose, which is needed for many bodily processes. One kind of sugar that may be stored for later use or utilized immediately for energy is glucose. In every 100 grams of serving of the most acceptable formulation could provide 29.75 grams of carbohydrates. In other words, this was comparable to the commercial *siomai,* which could also provide 19.18 grams of carbohydrates.

The study of Heben (2018) Nutritional content of Lawlaw contained a Vitamin A of 823 IU for a Serving Size of 100 grams. According to USDA National Nutrient database Kangkong fresh, raw leaves, Nutrition value per 100 g contained 6300 UI vitamin A. The *tinapang lawlaw-kangkong siomai* also revealed a vitamin A content of 558 IU which is a good source of vitamin A, essential for immune function. Having a 55.8 mcg of vitamin A is a respectable amount from the standard of 40-50 mcg of vitamin A (COT,2022). Hence, Socao et al., (2020) stated that Vitamin A is a crucial nutrient that plays a vital role in preserving optimal vision, especially in situations with little lighting. Additionally, it contributes to the maintenance of the immune system, the promotion of healthy skin and mucous membranes, and the support of growth and development. Whereas, including components such as *tinapang lawlaw* and *kangkong* in the *siomai* formulation, not only adds to the taste and texture, but also improves its nutritional value by supplying important vitamins and minerals.

In terms of Vitamin D_3 content, *tinapang lawlaw-kangkong siomai* revealed a 3mcg of vitamin d3 in the formulation, According to Institute of Medicine (2010) the Recommended Dietary Allowance for adults 19 years and older is 600 IU (15 mcg) daily for men and women, and for adults >70 years it is 800 IU (20 mcg) daily. According to Forbes Health (2024), vitamin D3 is necessary for the body to absorb and use calcium and phosphorus, two elements that are necessary for strong, healthy bones. Fish liver oils and fatty fish are among the dietary sources that naturally contain vitamin D3. Each meal of other animal products such as cheese, beef liver, and egg yolks also contains a trace quantity of vitamin D3.According to PharmEasy (2024), An important component of both sustaining and enhancing general health is vitamin D3. Its many potential health advantages, supported by research, have led to its huge rise in attention in recent years. One of the most important fat-soluble vitamins for overall health and wellbeing is vitamin D3. It is important because it helps maintain strong bones, muscles, and the immune system, among other things. A sufficient intake of vitamin D3 is essential for overall health. It strengthens your bones, strengthens your immune system, and promotes mental health. Everyone may benefit more from vitamin D3 if they are aware of their needs and where to obtain it.

The study of Akinsola et al. (2018) on crude fiber content of smoked fish reveal a range from 0.0 to 0.04% in smoked fish. According to USDA National Nutrient database Kangkong Nutrition value per 100 g contained 1g of fiber. Moreover, the crude fiber content of the *tinapang lawlaw-kangkong siomai* garnered 2.38%, suggesting that the formulation contains a moderate amount of fiber, wherein a parameter of 2-3 grams of crude fiber content was used as a standard basis for other formulation. This data supports the Dietary Guidelines for Americans' suggestion to eat fruits, vegetables, and whole grains high in fiber often. The function that fiber plays in gastrointestinal health, in treating or avoiding constipation, hemorrhoids, coronary heart disease, some types of cancer, and glucose regulation are among the other possible health advantages that are now being researched. U.S. Department of Health and Human Services and U.S. Department of Agriculture (2005). Harvard T.H. Chan School of Public Health (2022) reports that fiber may reduce the chance of acquiring heart disease, diabetes, diverticular disease, and constipation, among other illnesses. Because of fiber's beneficial effects on the gut microbiota, many illnesses may have a reduction in chronic inflammation through anti-inflammatory actions.

Estimated Selling Price of *Tinapang Lawlaw-Kangkong Siomai*

The cost of producing *tinapang lawlaw-kangkong siomai* is displayed in Table 11, which shows that the cost of tinapa per kilogram is 160.00 pesos. As used in the development of the siomai, the costing is as follows: 125gms of *tinapa* costs Php20.00; 125gms of *kangkong* amounted to Php7.50 at Php60.00 per kilo; 50gms of carrot used amounted to Php6.00 at Php120.00 per kilo; 30gms of onion used in the formulation amounted to Php3.60 at Php120.00 per kilo; 20gms of garlic amounted to Php3.20 at Php160.00 per kilo; 5gms of all-purpose flour amounted to Php0.225 at Php45.00 per kilo; 20gms of cornstarch amounted to Php1.20 at Php60.00 per kilo.

For the other ingredients, the summary of the costing is as follows: sesame oil was 110.00 pesos for 100 ml, and the 1.23 ml utilized was equivalent to Php1.353. One egg costs Php8.00, while, other commodities such as oil costs Php40.00; wrapper costs Php35.00; gloves cost Php2.00; water costs Php10.00; packaging costs Php35.00; electricity consumption costs Php5.49 and labor costs Php18.50. This has a total cost of Php215.45, with a markup of Php19.59, and 33 pieces of produce. When itemized, each will cost Php6.53. This study implies that *tinapang lawlaw-kangkong siomai* can now be manufactured, sold, and used as an additional source of nutrient-dense products.

Table 11

Estimated Selling Price of Tinapang Lawlaw-Kangkong Siomai

Quantity	Unit	Particulars	Unit Cost	Unit cost consumed	Amount
125	grams	Tinapa	P160/1000g	P20.00	P20.00
125	grams	Kangkong	P60/1000g	P7.50	P7.50
50	grams	Carrot	P120/1000g	P6.00	P6.00
30	grams	Onion	P120/1000g	P3.60	P3.60
20	grams	Garlic	P160/1000g	P3.20	P3.20
5	grams	All Purpose Flour	P45/1000g	P0.225	P0.225
20	grams	Cornstarch	P60/1000g	P1.2	P1.2

1.23	ml	Sesame Oil	P110/100ml	P1.353	P1.353
1	piece	Egg	P8/pc.	P8.00	P8.00
Total					**P49.87**
Other Expenses					
Oil					P40.00
Wrapper					P35.00
Gloves					P2.00
Water					P10.00
Packaging					P35.00
Electricity					P5.49
Labor (37/hour)					P18.50
Total Cost:					**P195.86**
Mark-Up Price(10%):		P19.59			
Grand Total:					**P215.45**
Yield:					33 pcs/20g
Cost per piece:		**P6.53**			
Market cost per Pack:		P26.12 per pack/4 pieces			

The table above discloses the estimated selling price of *tinapang lawlaw-kangkong soimai*. The cost study for the *tinapang lawlaw-kangkong* dish indicates that the whole production cost amounted to Php215.45. This figure encompassed the expenses for ingredients, oil, packaging, and labor, resulting to a unit cost computed at Php6.53, which is considerably less than the market price of PHP13.50 per piece. The mark-up price was Php19.59, indicating a reasonable profit margin for the seller.

The pricing breakdown per unit revealed that the *tinapa* accounted for the largest portion of the cost at Php20.00, followed by kangkong at Php7.50, and egg at Php8.00. The remaining ingredients, such as carrot, onion, garlic, all-purpose flour, and cornstarch, made up a relatively lower portion of the overall cost. The costs of sesame oil and packaging were comparatively inexpensive. The production output was 33 pieces, which is a satisfactory quantity given the recipe employed. The unit cost was computed at PHP6.53, which was below the market price of PHP13.50 per piece. This implies that the researcher possessed an advantage in terms of pricing and had the potential to draw in a larger consumer base.

Chapter 5

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter presented the research summary, findings, conclusions, and recommendations based on the results gathered after sensory evaluation and different analyses of the *tinapang lawlaw-kangkong siomai*.

Summary

This study developed and evaluated the product *tinapang lawlaw-kangkong siomai* to establish an innovative and nutritious product that may be acceptable to the public. The researcher formulated three formulations: formulation 1 with 125 grams of *tinapa* and 125 grams of *kangkong*; formulation 2 with 200 grams of *tinapa* and 75 grams of *kangkong*, and formulation 3 with 100 grams of *tinapa* and 150 grams of *kangkong*. Other ingredients remained constant throughout the development of the product.

After processing, these formulations underwent sensory evaluation to determine acceptability level of the sensory attributes of the product, *tinapang lawlaw-kangkong siomai*. Laboratory analysis was also used to assess the nutritional composition of the most acceptable *tinapang lawlaw-kangkong siomai* and the microbiological content of the three formulations. Specifically, the study answered the following questions: (1) What is the microbial load of the three (3) formulations for *tinapang lawlaw-kangkong siomai* in terms of: *Escherichia coli* Count; and *Salmonella* Count? (2) What are the sensory characteristics of the three (3) formulations of *tinapang lawlaw-kangkong siomai* in terms of: Appearance, Aroma, Taste and Texture?; (3) What is the Level of acceptability of the Tinapang Lawlaw-Kangkong Siomai formulations in terms of: Appearance, Aroma, Taste, Texture and General Acceptability?; (4) What is the proximate and nutritional compositions of the most acceptable Tinapang Lawlaw-Kangkong Siomai in terms of: Protein content, Moisture content, Ash content, Fiber content, Fat content, Carbohydrate, Vitamin A and Vitamin D3?; (5) What is the estimated selling price of the most acceptable formulation of Tinapang Lawlaw-Kangkong Siomai.

Findings

From the analysis of the data gathered, the following are the findings:

1. The microbial load of the three (3) formulations for *siomai* in terms of:
   a. *Escherichia coli* count was less than 10 CFU*/g for the three *tinapang lawlaw-kangkong siomai* formulations
   b. *Salmonella* count in a 25-gram formulation from *siomai*, was not detected; microbial load was within the typical allowed limit.
2. The following were the sensory characteristics of T*inapang Lawlaw-Kangkong Siomai:*
   a. Appearance in terms of color: formulation 1 with 125 grams of *tinapa* and 125 grams of kangkong got a mean score of 3.41 was brown; formulation 2, containing 200 grams of *tinapa* and 75 grams of *kangkong*, received the mean score of 2.36, was also brown; while, formulation 3 with 100 grams of *tinapa* and 150 grams of *kangkong* got a mean score of 1.75 was light brown.
   b. Aroma: formulation 1, got a mean score of 3.71, had a weak aroma despite the moderate of the kangkong, and given a mean score of 1.91. This meant that an equal amount of *tinapa* and *kangkong* still gave off the dominant *tinapa* aroma.
   c. Taste: in formulation 1, the *tinapa* taste got a mean score of 2.94; *kangkong* taste got a mean score of 2.48; and saltiness got a mean score of 2.5.
   d. Texture: formulation 1 got a mean score of 2.26 or described as firm. All formulations provided a firm texture, implying that the mixture can be formed or shaped into *siomai* and that it is comparable to the existing *siomai* in the market.
3. Using a 9-point hedonic scale, the panelists scored the three formulations' acceptability levels according to:
   a. Appearance of color: the weighted means of formulations 1, 2 and 3 were 8.04, 7.84, and 7.72, described as *Like Very Much* indicating that there was a strong preference for the 3 formulations.
   b. Aroma: formulation 1 (7.78) received the highest acceptability score among the three, indicating that it was *Liked the Most* in terms of aroma. Formulation 2 received a score of 7.62; while formulation 3 with a mean score of 7.5, received the lowest liking score among the three, indicating that it was *Liked the Least* in terms of aroma. So, based on the results, formulation 1 is the most preferred in terms of aroma, followed by formulation 2 and then formulation 3.
   c. Taste: in terms of taste, formulation 1 and 2 got a mean score of 7.92 and 7.64, described as *Like very Much;* while formulation 2 got a mean score of 6.96, described as *Like Moderately*.

d. Texture: formulation 1 which had an equal amount of *tinapa* and *kangkong*, had the highest level of acceptability with a mean score of 8.04, followed by formulation 3 with a mean score of 7.72, which they rated as *Like Very Much*, and formulation 2, with a mean score of 7.06, was rated as *Like Moderately*. The panelists' evaluations for the *tinapang lawlaw-kangkong siomai* served as the basis for this result. The formulation with the same quantity of kangkong and Tinapa was the one the panelists liked most.
4. On the proximate and nutritional compositions of tinapang lawlaw-kangkong siomai, results reveal the following:
a. Protein content is 11.3 grams per 100 grams of the product;
b. Moisture content is 56.4 grams;
c. Ash content is 2.96 grams
d. Crude Fiber is 2.38%
e. Fat content is 8.51 grams
f. Carbohydrates is 29.75 grams;
g. Vitamin A is 558 IU;
h. Vitamin D_3 less than 3 mcg;
5. The estimated selling price of *tinapang lawlaw-kangkong siomai* is Php6.53 each with a markup price of Php19.59, considering all the items, the had a total cost of Php215.45. Thirty-three pieces of siomai weighing 20 grams each were produced in a single batch.

Conclusions

The conclusions of the study are the judgments or decisions reached by the researcher after the deliberations based on the results of the findings of the study. The following conclusions were drawn.

1. The microbial load of the three (3) formulations is concluded into microbiological aspect.
a. The *tinapang lawlaw-kangkong siomai* is concluded to have a low risk of contamination and thus a safe product for consumption.
b. Without the presence of *salmonella*, it is free from harmful pathogens ensuring that it meets the standard safety.

2. The sensory characteristics of *tinapang lawlaw-kangkong siomai* was obtained and thus:
a. The appearance of color is significantly influenced by the ratio of *tinapa* to *kangkong* in the *siomai* mixture. Hence, additional mixture tends to darken the color of soimai.
b. The proportion of *kangkong* in the mixture should be carefully balanced to achieve the desired aroma profile, as excessive amounts of *kangkong* overpowers the *tinapa* aroma.
c. The taste of *tinapa* was generally considered the most favorable among the three formulations, which may not be as strongly perceived by the respondents.
d. The texture is consistent and can be molded or shaped into *siomai* that is comparable to the existing products in the market. The uniform firmness of the formulation suggests that it has the potential to be a reliable and consistent product.

3. Using a 9-point hedonic scale the following sensory by panelist was concluded.
a. The formulations are well-received by the consumers, and color appearance is a key attribute that contributes to their overall liking.
b. Formulation 1 has a unique or appealing aroma that is more pleasing to the senses than the other two formulations.

c. The formulation with the same quantity of *kangkong* and *tinapa* may have had a more balanced flavor profile.

4. The proximate and nutritional composition of *tinapang lawlaw-kangkong siomai.*

a. The product can be considered a good source of protein for individuals who require a moderate protein intake.

b. The high moisture content of the product indicates that it may be prone to spoilage, mold growth, and other forms of degradation over time.

c. A significant portion of the product's weight is comprised of inorganic minerals and other non-carbonaceous substances.

d. While the product may contain some dietary fiber, it may not have as much fiber as other goods that are expressly described as "high-fiber" or "fiber-rich."

e. The product's significant fat content underscores the significance of nutritional labeling and openness in the food sector, enabling consumers to make well-informed decisions on their dietary preferences.

f. The presence of carbohydrate is concluded that it can be served as a minimal supplemental support in containing moderate carbohydrate.

g. The *siomai* is concluded to provide a valuable addition of vitamin A needed by the body.

h. The product may not sufficiently fulfill the daily vitamin D3 requirements, necessitating the consumption of additional sources of vitamin D3 to reach the recommended daily amount.

5. The estimated selling price of Tinapang Lawlaw-Kangkong Siomai is Php 6.53 per piece, which is a reasonable price considering the cost of production and the markup price added to account for profit and other expenses.

Recommendations

Based on the findings and conclusions, the following recommendations are hereby formulated.

1. Other formulations of the *tinapang lawlaw-kangkong siomai* and other ingredients can be done to improve the overall quality of the product.
2. Study on the shelf life and packaging of the *tinapang lawlaw-kangkong siomai* may be conducted.
3. Additional testing may be done on potential nutritional components of the product, such as vitamins D and C.
4. Future studies may examine the marketability of the *tinapang lawlaw-kangkong siomai* formulation in preparation for a potential economic endeavor.

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