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Research Article

Development and Acceptability of Tuyong Tawilis *(Sardinella tawilis)* Flavored Noodle

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ABSTRACT

This study examines the role of food innovation in the global noodle market, particularly addressing the nutritional limitations of many instant noodle products. It emphasizes the need for healthier alternatives to meet the growing demand from health-conscious consumers. Specifically, the study advocates for the development of high-protein noodle variants enriched with local flavors, such as "Tuyong Tawilis" (dried Sardinella tawilis), to enhance both nutritional value and market appeal. The innovative noodle variant's quality and safety are ensured by thorough evaluations that involve sensory analysis, physico-chemical, and microbiological investigation. This highlights the importance of flavor theory and new product development in meeting consumer preferences and promoting innovation. The study uses a quantitative approach with 220 respondents—experts and students—selected by convenience sampling to create, execute, and assess the "tuyong tawilis" flavored noodles. The research methodically applies the Input-Process-Output (IPO) Model. The results indicate "tuyong tawilis"'s potential as a major flavoring component and physicochemical as well as microbiological analysis verify its safety and adherence to consumption guidelines. Sensory assessments support the created product's acceptance by showing a moderate like for a variety of features. In summary, the study presents a novel and well-received flavored noodle product that satisfies changing customer preferences without sacrificing quality or safety. It helps the dynamic food business by combining traditional local flavors with contemporary tastes. It also offers potential pathways for healthier and more pleasant noodle alternatives, helping to shape the continuous evolution of culinary goods in the market.

Keywords*: Tuyong tawilis, Product development, Flavored noodle, Acceptability, Sardinella tawilis, Evaluation, Innovation*

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Introduction

Noodles have been a staple dish in many regions of the world for at least 2,000 years. It is believed that noodles are believed to have originated in China during the early rule of the Han Dynasty. However, it is disputed whether the contemporary form of the stringy pasta was created by the Chinese, Italians, or Arabs. They were then diversified by experimentation and the evolution of additional shapes and cooking methods. Noodles further gained cultural prominence via folklore related to 'health, religion, economy' and with the emergence of Chinese superstitions (Mehra, 2018).

Noodles are a well-known commodity second only to bread in terms of worldwide consumption. This may be prepared in a variety of ways that make for an appetizing meal for consumers. Unleavened dough is often rolled flat and sliced into long, thin strips to make noodles. This food item is often prepared by first cooking it in boiling water for a few minutes, adding the seasoning combination, letting it simmer for a further few minutes, and then adding the noodles. Asians eat noodles commercially and non-commercially, and instant noodles' quality depends on color, flavor, texture, cooking value, rehydration rates, and rancidity after storage (Gulia et al., 2014).

There are different kinds of noodles available on the market, and since instant noodles have a longer shelf-life expectancy, they have undergone extensive processing. Because of this, instant noodles have a poor nutritional value, more fat, calories, and salt, and are loaded with artificial flavorings, colorings, preservatives, and chemicals (Saxena, 2017). Noodles' poor nutritional value is caused in part by the fact that they are often manufactured from refined wheat flour, in which the bran and germ have been removed. As a result, many of the vital vitamins and minerals included in whole wheat are lost. Furthermore, manufactured noodles could be heavy in salt and preservatives, both of which can be harmful if ingested in excess. This describes the importance of food innovation since healthy eating is becoming more popular; increasing noodles' nutritional content might also raise their attractiveness.

Traditional instant noodles are made by combining water, salt, and wheat flour into a dough, rolling it into a thin sheet, and cutting it into strips. Traditional wheat flour noodles are high in carbohydrates but low in protein. The invention of Jung (2008) stated that it is possible to acquire enough high-quality protein for instant noodles by blending protein-rich foods into soup bases or adding eggs during cooking. Noodles made from fish paste have a lower integrity than those made from other types of dough since wheat flour is used as the major ingredient in their preparation. A further problem with fish paste noodles is that it is made by chopping fish pastes into little pieces and then frying them, which causes the water on the surface to evaporate while leaving the moisture within the noodles intact. The moisture content of fried fish paste noodles is more than 10%. The high water content of the noodles makes their long-term storage difficult. There is around 35%-40% water in fish paste if it is compressed.

Given that conventional noodles are frequently heavy in carbohydrates, and some innovations incorporate fruits and vegetables, which supply extra vitamins and minerals, the demand for high-protein noodles is obvious in today's health-conscious society. People may enjoy tasty and substantial meals while making considerable progress towards attaining their health and wellness objectives by using high-protein noodles in their meals. Trying new components, formulations, and procedures—or combining/infusing many different ingredients, formulations, and procedures—is a crucial component of innovation if you want to provide something new to the market that consumers will find compelling (Gibert & Prusa, 2021).

Food flavoring has long been a competitive advantage for restaurants all around the world. When anything alters or modifies the food's inherent flavor, it is referred to as flavoring. Combining flavorings can create a unique flavor that makes it hard to distinguish between the separate flavorings. Even if people are growing more health conscious and seeking out healthy meal options, taste is still crucial to the success of the food industry. Some people have experimented with utilizing natural flavoring blends instead of the market's heavily processed goods. Drying and powdering fish and fishery

items that are indigenous to people's habitats is one alternative native flavoring process utilized by some.

One of the popularly known dishes by Filipinos is *"Tuyo*." It refers to dried fish typically salted not just for longer shelf–life but also to give additional flavor to the product. People consider this product as poor man's food because of its affordable price. Native Filipinos prefer eating *"Tuyo"*. Eating *"Tuyo"* was not a preference to others; rather, they just considered this product as an affordable meal to them (De Leon, 2020). One of the most common types of fish used for making tuyo is Tawilis. *Sardinella tawilis*, sometimes referred to as freshwater sardines or Tawilis, is one of the most significant inland fish, both commercially and biologically. It is the only freshwater sardine in the world and the most economically important fish in Taal Lake in the Philippines (Adajar et al., 2017). Since they are captured in large commercial quantities and are accessible all year long, they are always a cheap source of animal protein (Magsino, 2012). In the fast-moving and growing food industry, innovation is a must. According to Safefood360.com (2015), the capacity to innovate is crucial to the food industry's existence and profitability.

Consumers are always seeking new products, and this is due to their constant evolution of demands and product expectations that must be met by the food industry. Establishments offer diverse products but still need to change in some way, or else they will be left behind. Part of the crucial aspects of food innovation is to develop a product that is classified to be acceptable. The interaction that food has with the consumer at any particular time is a direct indicator of food acceptability. Whether food meets customer needs and expectations determines whether it will be accepted. Since individuals intentionally select meals with certain sensory qualities, the sensory qualities of food are the primary elements that affect food acceptability. The qualities of the customer and the enjoyment of eating are additional important variables that directly affect food acceptance (Maina, 2018).

Consequently, noodles have been modified into different varieties using local seasoning ingredients that would suit their native taste. Among the most popular flavors of instant noodles in the Philippines are beef, chicken, pork, and seafood are some more preferred tastes. Moreover, some companies have more unusual tastes, such as spicy chicken, tom yum, and mushroom chicken. Noodles now offer Pad Thai and Japanese Pan Noodles, as well as more recent dishes like Grilled Orange Chicken Lo Mein and Spicy Korean Beef Noodle, which have robust and soothing Asian tastes (Moore, 2022).

Noodles come in a wide variety of tastes, and businesses and producers are constantly seeking new methods to create and promote new flavors to consumers. The use of exotic spices and seasonings, the addition of uncommon ingredients like vegetables or fruits, and the development of fusion tastes that mix flavors from many cuisines are some frequent flavor advancements in the noodle business. Along with this modernization, people became open to innovation that introduced instant noodles with different flavoring mixes being enjoyed by many people in different states of life. The native Filipinos, for example, enjoyed noodles as a dish accompanied by *"tuyo"* (dried fish).

The general problem of this study is how to develop a "tuyong tawilis" flavored noodle, a novel food product that integrates a culturally significant and nutrient-dense fish species endemic to the Philippines. Specifically, this study aims to determine the essential ingredients, tools, and equipment required to develop the noodle, following standardized food formulation and prototyping methodologies (Ali et al., 2020). In addition, it will outline the appropriate step-by-step procedures in creating the product based on best practices in fish-based food processing and culinary adaptation (Arihara, 2006). The development phase will emphasize the balance between traditional flavors and modern nutritional needs, contributing to both food innovation and local economic opportunities.

Equally important to product development is ensuring its microbial safety and shelf stability. This study will conduct microbial analyses of the "tuyong tawilis" flavored noodle, focusing on Aerobic Plate Count, Yeast and Molds, Coliform, *Staphylococcus aureus*, and

Salmonella levels. These tests are crucial, as foodborne pathogens remain a major concern in dried and semi-processed fish products (Yadav et al., 2022). In addition, the physicochemical properties of the noodle will be assessed, including moisture content, fat levels, water activity, and pH—factors that significantly influence product quality, texture, shelf life, and consumer perception (Chen et al., 2020).

Lastly, the study will evaluate the consumer acceptability of the developed product using sensory testing. This will include an assessment of its appearance, aroma, taste, texture, and overall acceptability using a structured hedonic scale. Sensory characteristics are critical in determining market success, as they directly affect consumer preference and repeat purchase behavior (Pathare et al., 2013; Srivastava et al., 2021). Through this comprehensive approach, the research seeks not only to create a scientifically validated and market-ready food product but also to contribute to the growing body of knowledge in functional food development, particularly in the context of Filipino aquatic resources and sustainable food systems.

The development of an innovative noodle product like "Tuyong Tawilis Flavored Noodle" may contribute to the body of knowledge through the following means: preserving and promoting cultural and culinary traditions, diversifying flavor chemistry through original flavor creation, researching consumer preferences, advancing food processing technology, and encouraging creativity in culinary arts. Knowing that noodles are one of the most eaten meals by Filipinos and that there are opportunities for innovating such products to create a variety of this meal that will be acceptable for the consumers, the researcher came up with the study entitled Development and Acceptability of "Tuyong Tawilis" *(Sardinella tawilis)* Flavored Noodle.

Methodology

Methods and Techniques of the Study

The conduct of the study gives emphasis to developing a product that was employed through developmental research. It produces an innovation of noodle products that have a distinctive flavor through the use of "tuyong tawilis". According to Kowalczyk (2014), developmental research has been characterized as the systematic study of creating, implementing, and assessing procedures and products that must fulfill criteria of internal consistency and effectiveness. The situations that include examining, recording, and evaluating the process of producing a product fall under the category of developmental research. The specified population of the respondents was given emphasis to assure the acceptability of the product, which has given weight in this study to engage in credible sensory evaluation of the product.

The researcher employed the quantitative method, particularly survey questionnaires. The quantitative research method was used in the study, which emphasizes objective measurements and the statistical breakdown of data gathered using survey questionnaires. A 9-point hedonic scale assessment questionnaire was used in this study's survey questionnaires to collect data, which helped in the collection of quantifiable data. Quantitative research is the systematic analysis through the gathering of quantifiable data and using statistical or mathematical methods (Fleetwood, 2018). By sending out survey questionnaires, polls, and votes, as well as utilizing sampling techniques, quantitative research gathers data from current and future clients.

As shown in Figure 1, the study was divided into 3 phases, namely: (1) conceptualization and planning, (2) product development, and (3) establishment of acceptance criteria.

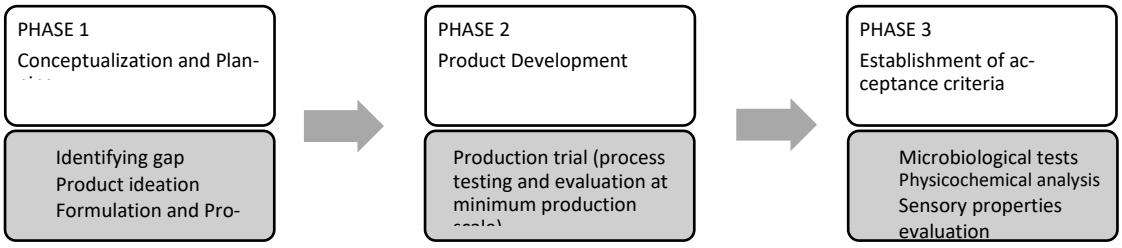

Figure 1. The Developmental Phases of Tuyong Tawilis (Sardinella tawilis) Flavoring Noodle

Phase 1: Conceptualization and planning. The researcher's work was built on the initial conception of the product motivated by the identified gap. The problem with this is that a variety of additives are frequently added to noodles to increase shelf life and flavor, but these preservatives are said to have adverse effects on individuals; besides this, there are many noodle innovations to improve nutritional value, but few give emphasis to providing distinctive flavor using fish products. As a result of this gap and the ideas that it provides, product ideation was created. After a thorough analysis of market data, authorized requirements, and available resources, the concept for the idea or the product was developed. After getting a thorough knowledge of the product concept, the researcher carried on with formulation and process design in order to generate the product as intended.

Phase 2: Product Development. The researcher ran a production trial based on the product model. The formulations and process designs were assessed using scale-up resources, which are normally determined by the minimum run on the manufacturing floor. Considering the available resources (men, materials, minutes, machines, and methods), capabilities and restrictions, efficiency, and optimization of the project's overall strategy, the researcher has evaluated the viability of the product and process design at this stage.

Phase 3: Establishment of acceptance criteria. Several tests were run on the results of the production trial in order to establish the initial product requirements. The researcher has sent samples to a laboratory testing facility for microbiological tests to determine the levels of Aerobic Plate Count, Coliform, Escherichia Coli, Staphylococcus Aureus, and Salmonella. Lead times for these tests were one week after providing samples to the laboratory facility. The researcher has collected each and every outcome, totaled them, and recorded them.

After passing the microbial test, the researcher examined the product to determine its acceptability based on its appearance, aroma, taste, texture, and overall acceptability. The researcher has employed the acceptance test, which is an emotional kind of sensory evaluation. During acceptance testing, products are rated on a scale of acceptability. It uses a 9-point Hedonic scale for its rating criteria.

Population and Sample of the Study

Respondents of the study were healthy people who didn't have any allergy to any kind of food and were free from color blindness. It involves twenty (20) trained experts assigned by the BulSU Analytical Testing Center to assess food products in relation to sensory evaluation and validation that are anonymous in mark with ethical protocol, two hundred (200) students from Bulacan State University – Bustos Campus with a minimum age of 18 years old considering that this bracket are the potential consumers of the product and are illness-free associated to sensory properties. As shown in Table 1, there are a total of two hundred twenty (220) respondents who met the inclusion criteria of the study.

Convenience sampling was used in this study because it is especially helpful when you need to get a certain sample rapidly, and the respondents were people who showed a willingness to take part in the data gathering so that they could give feedback on the product. This method of sampling can be mainly beneficial in particular to achieving certain samples quickly

(Hassan, 2022). Convenience sampling is a non-probability sampling technique that includes choosing research respondents from a pool of people who are willing and accessible to take part. Though it may affect generalizability, when time or resources are constrained, convenience sampling can be helpful; market research and sociological studies frequently employ this technique.

Table 1. Distribution of the Respondents

Respondents Category	Frequency
BulSU Analytical Testing Center Trained Experts	20
BulSU Bustos Campus Students	200
Total Respondents	220

Research Instrument

The research instrument used in this study was adopted from the BulSU Analytical Testing Center, Malolos, Bulacan. The first part is the microbial instrument, which is composed of aerobic plate count, yeast and mold, coliform, staphylococcus aureus, and salmonella. The second part is the physicochemical questionnaire, which includes fat, moisture, and water activity. The third part is the sensory evaluation instrument, which consists of appearance, aroma, taste, texture, and overall acceptability. Consumer panelists were requested to rank the degree of liking for a variety of products on a 9-point Hedonic Scale based on classified samples. According to their taste for each sensory property type, respondents rated each category on a scale from extremely like to extremely dislike. The categorization scales used range from extremely like to extremely dislike, with different groups in between. By selecting the proper type, panelists said how much they liked each sample.

Data Gathering Procedure

The evaluation instrument used the following criteria: appearance, aroma, taste, texture, and overall acceptability. The researcher assured the confidentiality of their survey sheets following research ethics. The evaluation process was done through the following procedures: (1) the respondents were given questionnaires, (2) the researcher gave the respondents the product sample, (3) the respondents rated the product based on the evaluation criteria, (4) the ratings were tabulated, (5) the mean of each criterion and the overall mean of the respondent's ratings were computed, and (6) the range of the numerical ratings and their corresponding descriptive criteria were presented.

Ethical Considerations

Ethical considerations are prioritized and methodically observed to ensure the rights and voluntary participation of the respondents are upheld throughout the research process. The researcher recognizes the importance and fundamental value of respecting the autonomy and privacy of the individuals involved. Prior to any data collection activities, the researcher takes the necessary steps to secure essential permissions. This includes obtaining the required approvals from relevant authorities or institutions overseeing the research. A comprehensive set of documentation is prepared, encompassing a letter addressed to the respondents, informed consent forms, and the research instrument. The letter addressed to the respondents serves as a means of communication, outlining the purpose, nature, and scope of the study. It provides a transparent overview of what the respondents can expect, and it may include information about the potential risks and benefits associated with their participation.

The informed consent forms are crucial components in ensuring that respondents are fully aware of their participation in the course of the study. These forms detail the purpose of the research, the procedures involved, the expected duration of participation, and any potential risks. Importantly, the forms emphasize the voluntary nature of participation, making it clear that respondents have the right to withdraw from the study at any point without facing adverse consequences. The researcher

commits to safeguarding the privacy of the respondents by ensuring that any information shared during the study remains confidential. Respondents are assured that their identities will be protected, and they are given the option to participate anonymously through the use of the research instrument.

Furthermore, before engaging in any data gathering procedures, the researcher takes the time to adequately inform and orient the respondents of the study. This step ensures that respondents have a clear understanding of the research objectives, the methods employed, and the expected outcomes. By providing this information, the researcher empowers respondents to make informed decisions about their involvement in the study.

Data Processing and Statistical Treatment

The Hedonic Scale was used to assess the developed product. The 9-point Hedonic Scale is the most often used scale for assessing food acceptability because it is effective at demonstrating differences in the degree of liking among items. The scale rapidly became the favored hedonic scaling tool. It is currently perhaps the most commonly used scale for this purpose (Garde & Ebeler, 2017). The scale was created at the Quartermaster Food and Container Institute of the United States by David Peryam and colleagues in the Armed Forces to gauge soldiers' food preferences. The scale was then shortly embraced by the food sector and is today used to rate the acceptability of foods, drinks, as well as cosmetics, home goods, and personal care items.

The descriptive rating and the numerical equivalent were as follows: *Like extremely* if the score is 8.12-9.00, *Like very much* if the score is 7.23-8.11, *Like moderately* if the score is 6.34-7.22, *Like slightly* if the score is 5.45-6.33, *Neither like nor dislike* if the score is 4.57-5.44, *Dislike slightly* if the score is 3.68-4.56, *Dislike moderately* if the score is 2.79-3.67, *Dislike very much* if the score is 1.90-2.78 and *Dislike extremely* if the score is 1.00-1.89.

Below is the 9-point Hedonic scale used to measure the acceptability of the project's developed output, and shall be used as a grading tool by the respondents.

Numerical Rating	Descriptive Rating
8.12-9.00	Like extremely
7.23-8.11	Like very much
6.34-7.22	Like moderately
5.45-6.33	Like slightly
4.57-5.44	Neither like nor dislike
3.68-4.56	Dislike slightly
2.79-3.67	Dislike moderately
1.90-2.78	Dislike very much
1.00-1.89	Dislike extremely

Results and Discussion

Ingredients, Tools, and Equipment Used in Developing Tuyong Tawilis (Sardinella tawilis) Flavored Noodle.

The following was the product formulation list of all the raw ingredients needed, as well as tools and equipment used to develop the tuyong tawilis *(Sardinella tawilis)* flavored noodle. The product was produced utilizing powdered tuyong tawilis, bread flour, all-purpose flour, garlic powder, onion powder, and water. The tools and equipment to enable the production process were a measuring cup, weighing scale, casserole, strainer, basin, ladle, screen mesh, knife, chopping board, food grinder, bowl, mixing bowl, wire whisk, noodle roller/cutter, frying pot, stove, and sealer. To ensure a safe production process, the researcher used a 25ml chlorine to 5l purified water ratio, formulating a 100-ppm chlorine solution to sanitize the workspace. The dishes and equipment were submerged in a 20-ppm chlorine solution, which had been prepared by combining 5 ml of chlorine with 5 liters of clean water, and then left to air dry overnight.

A facemask, lab clothing, apron, hairnet, and gloves were worn in the lab to preserve product safety and prevent contamination. All the aforementioned sanitary processes were employed in line with the postulation of Fung et al. (2018) that food safety is a fundamental human right since it is vital for life. Since foodborne ailments arise when pathogens, or disease-causing germs, enter food and multiply to harmful levels before being digested (Canadian Institute of Food Safety, 2019). This is why it is imperative to observe proper food handling techniques and procedures to safeguard consumers.

Procedures Required in Developing Tuyong Tawilis *(Sardinella tawilis)* Flavored Noodle.

The flowchart below shows the process framework of the procedures required, followed by the narrative description of each method.

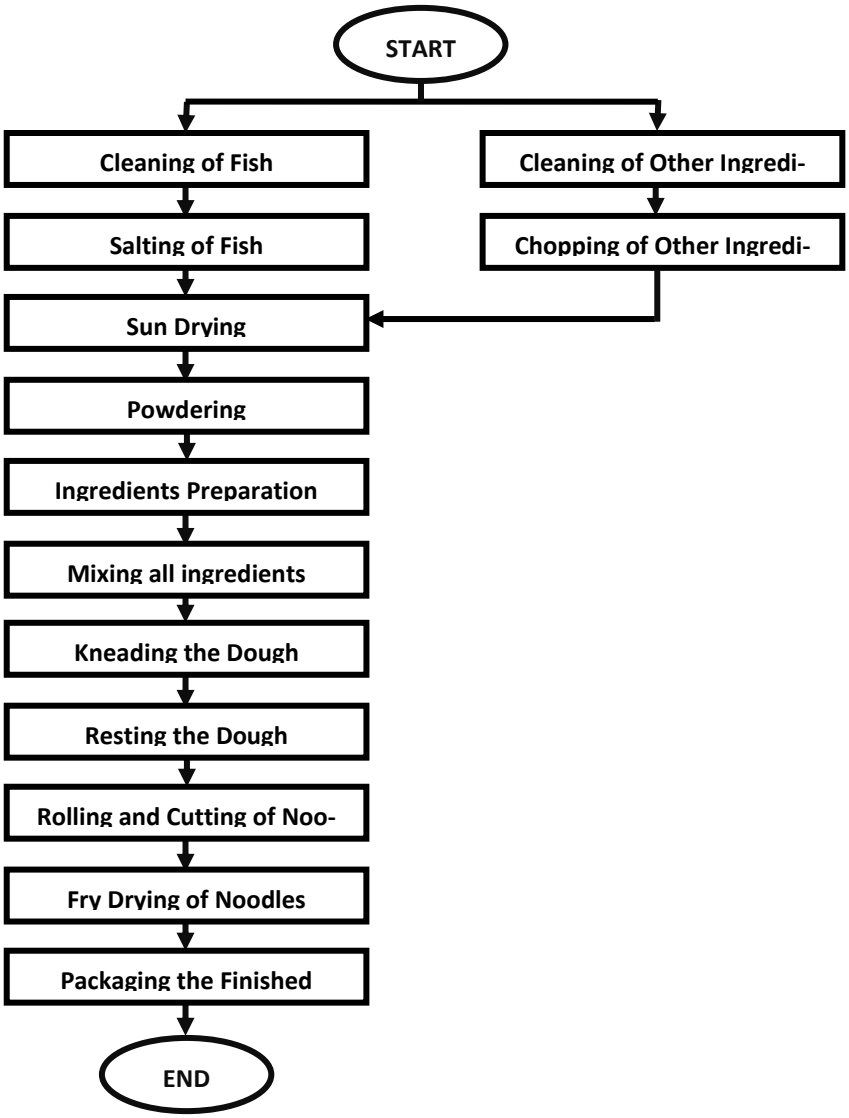

Figure 1. Process framework of the procedures used in the development of tuyong tawilis (Sardinella tawilis) flavored noodles.

Preparation of Product Sample

The research systematically assesses the safety, properties, and viability of the product by employing a method of sample creation. Thorough cleaning of the fish was the first step conducted to eliminate contaminants, then after, the fish was immersed in a brine solution for flavor enhancement. Subsequent sun-drying was done to achieve an optimal crispness of the fish suitable for grinding. Onions and garlic were meticulously sliced and dried separately until reaching the requisite dryness for powdering. The dried components were then finely ground, precisely mixed, and accurately weighed in adherence to the specified recipe on making the product. The dough, a critical element in the production process, underwent a series of thorough steps, including kneading to ensure uniform distribution of all ingredients within the dough, resting to facilitate gluten

development, rolling of the dough to achieve the desired thinness, and cutting into noodles. The brief frying of the noodles served the purpose of reducing moisture and water activity. Following frying, the noodles were carefully cooled and packaged to mitigate the risk of any possible contamination. This comprehensive and systematic procedure is designed to uphold stringent standards of safety, quality, and precision in the production of noodles.

The researcher employed percentages to record trials for the formulation of the developed product of the study using a combination of bread flour and all-purpose flour as the base ingredient. Combining two different types of flour helps balance all-purpose flour's lack of gluten and bread flour's overpowering flavor. The most suitable quantity of tuyong tawilis powder to be mixed with the noodle combination was determined by the researcher throughout the product's development using the following percentages: 30, 25, 20, and 15. This method was in reference to the studies by Lauzon et al. (2016), wherein three amounts of fishbone powder (1, 5 and 10%) and (25, 37.5 and 50%) squash paste were utilized in the development of vegetable-fish noodles and Shikha et al. (2020), wherein, wheat flour and other materials were combined with minced silver carp fish at replacement ratios of 0, 20, 25, and 30%.

The addition of 30% tuyong tawilis powder to the product combination produced a product with a distinctive flavor but had trouble producing noodle products that could maintain its elasticity. The consistency of the mixture, which contained 25% tuyong tawilis powder, had the same problem despite the fact that the finished product had a better hold on its elasticity when used to create noodles. 20% tuyong tawilis powder, which is incorporated into the mixture, was found to retain its distinct tuyo flavor and preserve its form as a noodle. The result when adding 15% tuyong tawilis powder to the combination was a great noodle with acceptable texture and noodle product characteristics, but the product lacked a unique flavor, making it blunt in terms of taste. The mixture with 20% tuyong tawilis powder is the most suitable formula, according to the results of the subsequent testing, and was utilized to create the study's final product.

Microbiological Properties of the Tuyong Tawilis Flavored Noodle

Table 2 shows the initial microbial properties of the product as analyzed by a third-party laboratory:

Table 2. Microbiological Properties of the developed trying tawilis (Sardinella tawilis) flavored noodle

Parameter	Result	FDA Standard Value
Aerobic Plate Count, cfu/g	$>10^4$ cfu/g	$>10^5$ cfu/g
Coliform Count, cfu/g	$>10^2$ cfu/g	$>10^3$ cfu/g
Yeast and Molds Count, cfu/g	$>10^4$ cfu/g	$>10^5$ cfu/g
Staphylococcus Aureus, cfu/g	$>10^3$ cfu/g	$>10^4$ cfu/g
Salmonella	Negative	Negative

As shown in Table 2, the microbiological properties of the developed product were measured in terms of Aerobic Plate Count, which resulted in less than 10^4 cfu/g passing the FDA standard value of less than 10^5 cfu/g, Coliform Count, which resulted in less than 10^2 cfu/g passing the FDA standard value of less than 10^3 cfu/g, Yeast and Molds Count, which resulted with 10^4 cfu/g passing the FDA standard value of 10^5 cfu/g, Staphylococcus Aureus Count, which resulted with 10^3 cfu/g passing the FDA standard value of 10^4 cfu/g, and Salmonella, which resulted with negative. Food items may encounter a range of health concerns as they go from the farm to the manufacturing to the table. According to Gizaw (2019), food that has been contaminated by dangerous biological contaminants or chemicals can cause more than 200 infections, from cancer to diarrhea. An estimated 600 million individuals get sick after consumption of contaminated food each year, 420,000 people pass away, and 33 million DALYs (disability-adjusted life years lost) are lost as a result. This reason makes it

very vital that the developed product undergo and pass the microbial test.

The sample has Aerobic Plate Count, Coliform Count, *Staphylococcus aureus*, and Yeast and Mold Count Values that are within the FDA Microbiological Standards. The sample has PASSED all the parameters of microbiological quality. (AOAC Official Methods of Analysis, FDA Microbial Standards-DOH). The good microbiological quality of the product can be attributed to the freshness and good quality of the ingredients used. Sanitizing procedures were also employed to ensure that the noodle was produced under sterile conditions. The utensils, equipment, and workplace underwent sanitation with chlorine solution. The researcher observed proper hygienic practices and worked in a proper laboratory outfit to minimize the causes of contamination. This is in accord with the postulation of Sesotec (2020) that at every phase of the food production life cycle, safe food handling techniques and procedures should be used to decrease the risks and safeguard consumers.

Physicochemical Properties of the Tuyong Tawilis (Sardinella tawilis) Flavored Noodle

Table 3 shows the initial Physico-chemical properties of the product as analyzed by a third-party laboratory:

Table 3. Physico-chemical properties of the developed tuyong tawilis (Sardinella tawilis) flavored noodle

Parameter	Result
Crude Fat Content, %	8.1
Moisture Content, %	4.1
Water Activity Content, %	0.3

As shown in Table 3, the product has a crude fat content of 8.1%, moisture content of 4.1%, and water activity content of 0.3. The amount of fat in the product is indicated by the crude fat content. An 8.1% crude fat percentage in the tuyong tawilis-flavored noodle indicates a moderate fat concentration, which contributes to the product's overall flavor, texture, and mouthfeel. Fat contributes significantly to the sensory qualities of food by giving it a rich and acceptable flavor. Dietary fat should make up 20 to 35 percent of total calories for healthy individuals. For instance, if a person follows a 2,000-calorie diet each day, 400 to 700 of those calories should come from fat each day (Vercelletto, 2023). The value of water in a product is denoted by its moisture content. The product's moisture content of 4.1% shows that it has undergone an efficient dehydration process, resulting in a comparatively low moisture content. Because fewer bacteria may develop and there is a reduced probability of deterioration, the product's shelf life is increased by the lower moisture level. According to Mamat et al. (2017), dried noodles may be made utilizing a controlled drying process with a final moisture content of less than 14%. Drying is a traditional method of food preservation that provides a longer shelf life while also making the food lighter, smaller, and easier to store and carry than a wet product. The technique is also thought to increase food stability, limit microbial action, and lessen physical and chemical changes in food during storage.

Water availability for microbial development and chemical reactions within a food product is gauged by water activity (aw). A low level of accessible water, as indicated by a water activity content of 0.3, adds to the product's stability and shelf life. Low water activity reduces the chance of deterioration and preserves the quality of the final product by preventing microbial growth and enzymatic reactions. According to Levi (2016), the quantity of free water in a sample is known as its water activity. Undesirable microbes may use water that is not attached to the materials themselves, which might be one of the contributing elements to food deprivation. The Food and Drug Administration (2014) states that it is probable to reduce the available moisture to a level where the organisms' growth is inhibited. Most meals have a water activity of greater than 0.95, which offers sufficient moisture for

the growth of bacteria, yeasts, and mold. Food that has been preserved so that its water activity is 0.85 or below is resistant to the growth and degradation of germs. These factors help the product's overall sensory qualities and preservation, delivering a developed product for consumers.

Product Acceptability of the Tuyong Tawilis (Sardinella tawilis) Flavored Noodle

Table 4 shows the consumer acceptability of the product through a sensory evaluation test conducted among two hundred (220) respondents composed of two hundred (200) BulSU – Bustos Campus Students and twenty (20) trained panelists.

Table 4. Consumer Acceptability Grade of the tuyong tawilis (Sardinella tawilis) flavored noodle as evaluated by two hundred (220) respondents

Sensory Attributes	Mean	Interpretation
Appearance	6.7	Like Moderately
Aroma	6.9	Like Moderately
Taste	7.1	Like Moderately
Texture	6.8	Like Moderately
Overall Acceptability	7.1	Like Moderately

As indicated in Table 3, the evaluators gave the product's appearance a score of 6.7. Corradini (2019) suggests that appearance is influenced by the color quality of the illumination in terms of intensity, color temperature, and fidelity, as well as the nature of the product's structure. With this, the rating indicates that the panelists found the product's visual presentation to be "Like Moderately." The panelists gave the aroma of the tuyong tawilis-flavored noodle a grade of 6.9, which corresponds to a descriptive rating of "Like Moderately. "This means that the product had a distinguishable and distinctive aroma that the panelists accepted. A score of 7.1 for the product's taste indicates that the main flavoring ingredient has a distinct taste rated to be "Like Moderately ."This indicates that the product had a distinct and recognized flavor. Breslin (2013) stated that taste influences food selection, and greater knowledge of the connections between food flavor, individual taste preferences, food choices, and intake can help us understand people's preferences towards food.

The panelists defined the texture of the product as having a firm noodle quality and gave it a texture score of 6.8, which indicates a descriptive rating of "Like Moderately." This suggests that the product had a texture that was acceptable as firm noodles, which the panelists appreciated. Rothenberg and Wendin (2015) noted that the sensory experience of food texture has a substantial influence on a consumer's liking and preference for a food product. Food texture is a matter of consumer concern and interest that differs depending on the kind of food. The produced product received an overall acceptability score of 7.1, which translates to a description of "Like Moderately." This means that, overall, the study respondents found the tuyong tawilis-flavored noodle to be an acceptable preference. In conclusion, the respondents gave the newly developed product generally favorable scores for appearance, aroma, taste, texture, and overall acceptability. The product was appreciated by the respondents of the study, as evidenced by its light brown color, distinctive tuyong tawilis smell, noticeable flavor, firm noodle texture, and acceptable overall preference.

In conclusion, the respondents gave the newly developed product generally favorable scores for appearance, aroma, taste, texture, and overall acceptability. The product was appreciated by the respondents of the study, as evidenced by its light brown color, distinctive tuyong tawilis smell, noticeable flavor, firm noodle texture, and acceptable overall preference.

Conclusion

The conclusions that follow were based on and aligned with the study's findings: Tuyong tawilis can be used as the main flavoring

ingredient to develop flavored noodles. The ingredients, tools, and equipment, as well as the procedural requirement to enable the development of the tuyong tawilis *(Sardinella tawilis)* flavored noodle, were specifically identified. The microbiological properties of the developed product were known, and the result values were found safe for human consumption. The physicochemical properties of the developed product show the safe level of quantity for human consumption. Respondents' acceptability preference of the developed product's sensory attributes in general is described as moderate.

Recommendations

In light of the findings and conclusions of the study, the following recommendations were offered:

1. The finished product may be subjected to shelf-life study in predetermined environmental settings, specifically within ambient storage conditions.
2. The determination of appropriate packaging material for the finished product may be studied to allow maximized shelf-life stability.
3. The finished product may be subjected to nutrition analysis and additional tests for possible health claims.
4. The product may be tested using different formulations and methods of preparation to improve sensory attributes and overall organoleptic acceptability.
5. A follow-up test with a broader demographic or randomized sampling method may be conducted to further reinforce generalizability.

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