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Article

Sensory Evaluation and Product Acceptability of Breadnut (Artocarpus Camansi) and Sardines (Sardinella Longiceps) Powder Enriched Noodles

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Abstract: This research assesses the extensive use of breadnut (Artocarpus camansi) seeds powder and sardine (Sardinella longiceps) powder in the formulation of enriched noodles as the basis for Techno-Guide. The researcher utilizes Quasi-experimental research to formulate the three formulations of noodles in in various ratios of all-purpose flour plus breadnut seed and sardine powder in the different ratio (325 + 50: 25, 300 + 75: 35, and 275 + 100: 50) with 375 grams amount of flour as total and serve as the control making breadnut powder a substitute. The researcher utilizes modified Five-Point Hedonic to assess the characteristics and preference of noodles firmness, elasticity, texture, appearance, color, aroma, flavor, and palatability as evaluated by 30 panelists. The data obtained were analyzed using percentage, weighted mean, frequency distribution, standard deviation, T-test and Wilcoxon rank test. The findings of the study showed that breadnut and sardine enriched noodles were acceptable to trained and consumer panelists. The noodles look like versions that were commercially manufactured. The 25g sardine powder id liked very much in terms of aroma over the other formulation which has 35g and 50g of sardine powder. Although sardine powder can be used as a flavoring and a seasoning but not as a flour for making noodles, it weakens the gluten formation of the dough and affects elasticity. Moreover, the noodles are safe with desirable sensory properties and a high level of nutrients, making it an ideal raw material for food production. Based on the study results, it can be suggested that the development of techno guides be used by fishermen, home-growers, and homemakers as a livelihood for additional income.

Keywords: Quality Education, Inequality, Breadnut (Artocarpus camansi) powder, Sardine (Sardinella longiceps) powder, Enriched noodles

Introduction

Noodles are culinary masterpieces that perfectly represents human creativity. The intricate little curl, sticks, sheets, and dough strings, both fresh and dried, act as a gentle blanket for weak flavor layers and effectively make a daring culinary statement for sauces, hearty meats, and soups. (Roccetti, Marfia, & Zanichelli, 2010).

The Chinese, Italians, and Arabs all claiming that they have invented the noodles; however, Lu et al. (2005) found a pot of thin noodles stored in Yellow River slit for 4000 years pegged China's favorite cup. It indicates people ate noodles at least 1000 years earlier than previously thought, and several centuries before those dishes

were reported in Europe (Fu, 2008). Noodles in various formulations and shapes have been the most distinguished daily staple food for oriental cultures (Fu, 2008) for their attributes, including ease of digestion, moderate flavor, and hypoallergenic properties. Eating well-balanced, healthy meals and snacks, particularly in emergencies, may be challenging for most households. The COVID-19 pandemic had significant health effects and creates substantial economic tension (Ludvigson, & Ng,2020) with detrimental effects on food security, hunger, and malnutrition (Galanakis, 2020). Worldwide crises typically restrict family food options. Even if the food is available on the market, but people have reduced their physical access, or food stocks are insufficient in terms of quantity or consistency, or both (Cayabyab, 2020). Food and Agriculture Organization (FAO), 2020) noted that disrupting the food system due to COVID-19 worldwide has significantly affected developing countries like the Philippines.

In response to the COVID-19 and typhoon, President Rodrigo Roa Duterte stressed the role of local government units (LGUs), particularly village leaders, to work twice as hard to protect public health and food nutrition by delivering emergency food supplies (PCOO, 2020). DOST(2020) stated that one of the stages of providing relief is during the food requiring hot water or cooking. It is expedient to formulate survival foods and preserved them like noodles from the staple.

Food innovation has been introduced to students in K-12 under Entrepreneur based TLE. It embeds entrepreneurship concepts in teaching various subjects in Home Economics, which features lessons that equip students with skills and values to become productive, market-oriented, and customer-centered. Innovation refers to new or different ways of doing things or creates new products. Noodles are generally made from flour of some kind, water, and salt and formed into thin strips from the sheeted dough, although wheat flour makes the bulk of noodles, today, barley, buckwheat, cassava, corn, millet, mungbean, potato, rice or yam flours are utilized (Shelke, 2016). Production of starch to manufacture noodle products from various plant sources was practiced in China for centuries and subsequently spread to neighboring countries (Tan, Li, &Tan, 2009). Processing perishable starchy seeds of every fruit into flour extends the shelf life and use of the fruit. The flour that has been developed can be used to make new value-added products for local and export use (Nochera, & Ragone, 2019). Breadnut (Artocarpus Camansi) is a highly nutritious crop that contains macronutrients and micronutrients. This species is primarily grown for its nutritious seeds (Adeleke & Abiodun, 2020) and has a good source of energy (Ragone, 2006); it contains an appreciable amount of protein, carbohydrate, and mineral contents (Adeleke & Abiodun, 2020). Enibe (2012) attested breadnut or "Kamansi" crop could be made into flour and use in the production of flour-based products and are recommended for bakery industry and culinary uses (AdAmadi, Ndukwu & Nwachukwu, 2000). A similar study has conducted of Nochera & Ragone (2019) development of a breadfruit flour- pasta product guide efforts in developing new products from other cultivars to enhance its utilization and market potential underutilized crops. Therefore, the very cause for developing noodles becomes valuable not only in meeting starvation but in supplying the much-needed calories.

Moreover, even with the presence of the nutrients found in Artocarpus camansi, it is also very ideal for increasing essential nutrients, such as proteins, dietary fiber, and vitamins. Researchers' efforts are underway to improve the formulation,

extend the shelf life, and promote universal fortification of instant noodles. (Gulia, Dhaka, Khatkar, 2014). Sardine (Sardinella longiceps) "tuloy" in Cebu (Stuart, 2020) which are abundantly flooding, very affordable in the market (Lena, 2020) supplies protein for filipinos can be used as a fortified product to noodles. Accordingly, many researchers explore the potential of noodle fortification as an effective public health intervention and improve its nutritional properties. (Gulia, Dhaka, Khatkar, 2014). Noodles have been reported to incorporate various ingredients such as fish protein isolate (Desai et al.,2018) and adding dried meat powders, such as fish powders (Huda et al., 2000; Park and Lin, 2005) to enriched noodles with protein.

Noodle is one of the world's commonly devoured to cook foods and is the right vehicle for natural components approved by the Food and Drug Administration. However, minimal noodle experiments with natural components are performed (Deep et al., 2014). Therefore, owing to the advantages of Artocarpus camansi and sardinella longiceps and the increased demand for convenience foods as noodles, the study was conducted by incorporating Artocarpus camansi and sardinella longiceps in powdered form to the noodles and specifically this aimed to assessing the consumers' acceptability, cost- analysis and shelf life of the produced items.

This study aimed to develop an enriched noodle formulation using breadnut (Artocarpus camansi) seed powder and sardine (Sardinella longiceps) powder. The research explored different noodle formulations with varying amounts of breadnut and sardine powder while assessing their sensory characteristics, consumer acceptability, shelf-life, and cost-effectiveness. Three formulations (F1, F2, F3) were developed by adjusting the ratios of all-purpose flour, breadnut powder, and sardine powder. The study then evaluated the noodles based on firmness, elasticity, texture, appearance, color, aroma, flavor, and palatability, as perceived by both trained panelists and consumer respondents. Furthermore, the research identified the most preferred formulation, determined its shelf-life at room temperature, and conducted a cost analysis to assess its economic feasibility.

Research Objectives

This study aimed to develop and evaluate an enriched noodle formulation using breadnut seed powder and sardine powder. Specifically, it sought to:

1. Develop three noodle formulations incorporating different ratios of breadnut and sardine powder.
2. Evaluate the sensory characteristics of the different formulations based on firmness, elasticity, texture, appearance, color, aroma, flavor, and palatability as perceived by trained panelists and consumers.
3. Determine the most acceptable formulation based on the preferences of both trained panelists and consumer respondents.
4. Assess the shelf-life of the most preferred noodle formulation when stored at room temperature.
5. Conduct a cost analysis of the most preferred formulation to determine its economic viability.

Methodology

This study employed a descriptive-experimental research design to develop and evaluate breadnut (Artocarpus camansi) seed powder and sardine (Sardinella longiceps) powder-enriched noodles. The experimental phase involved formulating, preparing, and analyzing different noodle formulations, while the descriptive component assessed the sensory attributes of the developed noodles. Additionally, the study utilized statistical analysis to determine the acceptability of the product, the shelf-life of the most preferred formulation, and its cost-effectiveness. The study was conducted at Lipata National High School, located in Minglanilla, Cebu, under the Department of Education, Cebu Province, District of Minglanilla 2. The school has 56 faculty members, with 9 handling Technology and Livelihood Education (TLE). The school has 43 classrooms, one computer laboratory, and one TLE laboratory for cookery and bread and pastry production classes. The proximity of the school to local noodle and bihon manufacturers, such as Aibolyn Consumers Products and Ming Food World, provided a relevant industrial context for the research.

The study involved 30 evaluators, who were purposefully selected due to their expertise and availability. The respondents included: 10 TLE faculty members, 10 Technical-Vocational-Livelihood (TVL) Senior High School students, 10 parents of Lipata National High School students

These respondents were tasked with evaluating the sensory characteristics of the formulated noodles based on a modified Five-Point Hedonic Scale.

Product Formulation

Three different formulations of enriched noodles were developed, along with a control sample (F0). The formulations varied based on the amounts of breadnut flour and sardine powder, as shown in the Formulation Matrix below:

Formulation	All-purpose Flour	Breadnut Flour	Sardine Powder	Water	Oil	Salt
F1	325g	50g	25g	150g	30g	10g
F2	295g	75g	35g	150g	30g	10g
F3	270g	100g	50g	150g	30g	10g

Each formulation was designed to increase the proportion of breadnut and sardine powder, thereby enhancing its nutritional value.

Product Preparation Procedures

A. Breadnut Powder Preparation

1. Fresh breadnut seeds were collected, sorted, and washed.
2. Seeds were boiled for 35 minutes, dehulled, and sliced into small pieces.
3. The slices were oven-dried for one hour at a controlled temperature.
4. Dried slices were finely ground into powder using a grinder.
5. The resulting breadnut flour was sieved through a fine mesh sieve to ensure uniform consistency.

B. Sardine Powder Preparation *(Adapted from Chattopadhyay, Rao & Gupta, 2004)*

1. Fresh sardines were washed, dressed, and beheaded.

2. The fish was boiled at 100°C for 10 minutes to eliminate excess moisture and bacteria.
3. The boiled fish was oven-dried for one hour.
4. The dried fish was finely ground into powder for easy incorporation into the noodle dough.

C. Enriched Noodle Preparation

1. All dry ingredients (breadnut powder, all-purpose flour, sardine powder, and salt) were weighed and mixed.
2. Liquid ingredients (water and oil) were gradually added to the dry mixture while continuously stirring.
3. The dough was kneaded until a cohesive and elastic texture was achieved.
4. The dough was rolled out into sheets using a noodle roller.
5. The sheets were cut into thin strands (2-3 mm thick) using a noodle cutter.
6. The freshly cut noodles were weighed (50g per serving) and folded into mesh trays for drying.
7. The noodles were oven-dried at a controlled temperature to extend their shelf-life.
8. The dried noodles were cooled and packaged for evaluation and further testing.

D. Cooking Time Determination

1. Each noodle formulation was immersed in boiling water separately.
2. The cooking time was recorded for each formulation.

Data Collection and Instrumentation

The study used a modified sensory evaluation sheet based on the Five-Point Hedonic Scale, allowing evaluators to assess the firmness, elasticity, texture, appearance, color, aroma, flavor, and palatability of the different noodle formulations.

Hedonic Scale Rating	Weight	Category	Verbal Description
4.20 - 5.00	5	Liked Very Much	Highly satisfied with the product
3.40 - 4.19	4	Liked Moderately	Satisfied with the product
2.60 - 3.39	3	Liked Slightly	Moderately satisfied with the product
1.80 - 2.59	2	Disliked	Fairly satisfied with the product
1.00 - 1.79	1	Disliked Very Much	Not satisfied with the product

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Results and Discussion

Table 1. Percentage Distribution of Different Characteristics of Three Formulations (F1, F2, and F3) assessed by Trained and Consumer Panelist

Characteristics	**Rating**	**Formulation1**		**Formulation2**		**Formulation3**	
		%		%		%	
		Trained	Consumer	Trained	Consumer	Trained	Consumer
Firmness	1	0	0	0	0	0	0
	2	0	0	15	10	5	**70**
	3	10	10	30	**60**	**55**	20
	4	15	20	**40**	20	20	0
	5	**75**	**70**	15	10	20	10
Elasticity	1	0	0	0	0	5	10
	2	0	0	25	10	20	**70**
	3	20	10	10	**50**	15	0
	4	20	0	30	40	25	10
	5	**60**	**90**	**35**	0	**35**	10
Texture	1	0	0	0	0	0	0
	2	0	0	10	20	5	30
	3	5	0	**35**	**50**	**40**	**40**
	4	20	**60**	**35**	20	**40**	10
	5	**75**	40	20	10	15	10
Appearance	1	0	0	0	0	0	0
	2	0	0	15	**30**	15	**40**
	3	5	0	**45**	**30**	10	20
	4	25	40	35	**30**	**65**	30
	5	**75**	**60**	5	10	10	10
Color	1	0	0	0	0	0	0
	2	0	0	15	20	10	20
	3	5	0	25	0	20	**40**
	4	35	**60**	25	**70**	30	10
	5	**60**	40	**35**	10	**40**	30
Aroma	1	0	10	0	0	0	10
	2	0	**30**	5	40	25	20
	3	20	20	**65**	**50**	**50**	**40**
	4	**45**	**30**	25	10	20	10
	5	35	10	5	0	5	20
Flavor	1	0	0	5	0	5	0
	2	0	0	10	0	5	30
	3	5	40	30	**70**	**55**	**40**
	4	20	**50**	**55**	30	25	10
	5	**75**	10	0	0	10	20

	1	0	0	5	0	5	0
	2	0	0	10	0	5	10
	3	15	**40**	30	**60**	**65**	**60**
	4	35	30	**45**	30	20	10
Palatability	5	**50**	30	10	10	5	20

All 30 panelist both trained ad consumer evaluated the three formulations. The highlighted are the highest percentage of each characteristic in every formulation. Table 3 shows the percentage distribution of all characteristics based on the assessment of the trained and consumer panelists. Based on firmness both trained and consumer panelists agreed that formulation 1 is "Liked Very Much" at 70-75% while Formulation 3 is liked slightly by both consumer and trained panelist. In terms of elasticity, it is visible in Table 3 that 60% of trained and 90% of consumer panelists agreed that formulation one is the most elastic and 35 % of trained panelist agreed that formulation 2 and 3 are also most elastic while 35% trained and 70% consumer disfavour the elasticity of Formulation 3. This implies that the more breadnut and sardine powder being added the more the gluten formation which is responsible for elasticity is destroyed.

Meanwhile, Formulation one (F1) rated 75 and 60% which interpreted as **"Like very much"** or quality defined as very smooth, while Formulation two (F2) and Formulation three (3) is liked moderately however liked slightly by consumer panelists. This implies that the trained and consumer panelist prefer Formulation one (F1), which implies that the instant noodle with very smooth texture is mostly acceptable to the panelist. The result also indicates that the consumers and the trained panelists perceived the texture of the noodles equally in Formulation one but reacted differently on the rest of the formulation. Table 3 shows the data that testify that the appearance of formulation 1, 2, and 3Like Very Much by trained panellist while Formulation 1 and 2 is Like Moderately at 60 and 70% and 40 percent of them like slightly the formulation 3. This implies that the appearance of the three formulated noodles are the same with those that are sold commercially. In Table 3 the highlighted numbers are the highest percentage, In color attributes, 60% in formulation 1, 35% in Formulation 2, and 40 % were the percentage number that excels in every formulation assessment a which all described as Liked Very Much by trained panelist. This implies that the color for the three formulation is acceptable by the experts. On the other hand, consumers unanimously agreed 60% for formulation one and 70% in formulation 2 which is decribed as liked moderately and 40% among all consumers evaluated formulation 3 as liked slightly.

Furthermore, 40% trained and 50% consumer panelist like moderately the aroma of formulation one, 65% and 50% for formulation two and 50%and 40% agreed to Liked slightly the formulation three. This implies that formulation one with 25g sardine powder doesn't have distinct aroma compared to the rest of the formulations. On the other hand, 75 % trained and 50 % consumer liked Very much the flavour of the noodles enriched in breadnut and agreed in Formulation 3 that liked slightly. Moreover, 50 % Liked Very much in Formulation 1, 45% Like moderately in Formulation 2, and formulation 3 is liked slightly by trained panelist and consistently all formulation are liked slightly by consumer panelist. Summarizing all the results it

shows that all formulations are acceptable to the panelists however, the formulation rated the most acceptable in all characteristics is formulation one.

Table 2. Mean and Standard Deviation of Noodles Firmness as Evaluated by the **Trained** and Consumer Panelists

Firmness	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.65	4.60	3.55	3.30	3.55	2.50
Standard deviation	0.671	0.699	0.945	0.823	0.887	0.97
Interpretation	Liked very much	Liked Very Much	Liked moderately	Liked slightly	Liked moderately	Disliked

The three sample of different grams of breadnut and sardine are made into noodle were identical in appearance when uncooked, so it was not difficult to discern one from another. Table 4 presents the descriptive result of firmness of noodle when cooked in boiling water in 5 to 6 minutes. Firmness varies according to how long noodles are cooked (Suzuki, 2020) and was measured by time that the white core had vanished in a noodle (Raungrusmee, Shrestha,Sadiq, Anal, 2020).

Among three formulations, it was noticed that there was significant increase on water absorption of noodles in formulation three (100g breadnut and 50g sardine powder. This increase in water absorption is due to the kernel size of breadnut powder. Visually, all-purpose flour has finer size than the breadnut and sardine powder. Liu,Herald, Wang, Wilson, Bean & Aramouni (2012) reported that the kernel size of flour affected the size of flour particles and the level of starch damage. Using finely ground flour made the noodle produce high viscosity and high tensile strength.

Table 4 shows the result of the descriptive test of breadnut and sardine powder enriched noodles prepared in three formulations in different ratios of all-purpose flour, breadnut and sardine powder (Table 2). With regards to the mean scores pertaining to firmness, result showed that the formulation one (F1) noodles (50g breadnut powder and 25g sardine powder) was quality defined as "Extra firm" and described as Liked very much (4.65) while the formulations containing 75g % to 100g BSF were rated "firm to soft" or described as Liked moderately to Disliked (3.55-2.50). The firmness of the noodles was greatly affected by the particle size of the starch (all-purpose flour and breadnut powder). (Hatcher et al., 2002) reported that flour with fine particle size demonstrated greater high tensile strength, firmness, and hold its shape without breaking. Thus, all-purpose flour having finer particles compared to the breadnut and sardine powder, has maximum firmness and strength. Formulation three having the highest amount of breadnut powder (100g) and sardine powder (50g) creates high starch damage that makes it either firm to soft and like moderately to disliked by panelist (3.55- 2.5) while formulation one with (325g all-purpose flour, 50g breadnut powder and 25g sardine powder exhibited firmer texture which can hold its shape and not break during the cooking process. The findings further suggest that the firmness of the noodles became firm or al dente when noodles were made from the

mixture of all-purpose flour and breadnut powder at any level of substitution when not cooked but sardine powder should be at small percentage because it does not have a pasting capacity.

Table 3. Mean and Standard Deviation of Noodles Elasticity as Evaluated by the Trained and Consumer Panelists

Elasticity	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.40	4.80	3.75	3.30	3.65	2.40
Standard deviation	0.871	0.632	1.21	0.675	1.31	1.14
Interpretation	Liked very much	Liked Very Much	Liked moderately	Liked slightly	Liked moderately	Disliked

Elasticity is important to assess the edible quality of noodles. Elasticity is how an object recovers after it has been extended or squashed (Li, Obadi, Qi et.al, 2019) or resumes its normal shape after being stretched (Wafula, Manyali, Makokha,& Sifuna). Noodles is a fully non- elastic object, its elasticity is derived in part from the formation of gluten in the noodle, complemented by tapioca starch gel properties. In terms of elasticity mean scores, the formulation one which has 50g of breadnut and 25g of sardine powder got the highest mean with 4.40- 4.80 perceived as "Liked Very Much" and noodles in formulation 2 and 3 (75g and 100g of breadnut powder) got 3.30 and 3.65 respectively and perceived as "Liked Moderately" by trained panelist, while it got formulation 2 with 75g breadnut got 3.30 or liked slightly by trained panelist and formulation 3 with 100g breadnut and 50g sardine powder got 2.40 and perceived as "disliked " by consumer panelists. This implies that the amount of breadnut and sardine powder added greatly affects the elasticity of the noodles. Li, Obadi, Qi, et.al, (2019) reported that elasticity of the noodles due to a dynamic mechanism involving gluten and starch gel properties. Although breadnut was considered as wheat flour substitute because of its protein and gluten content (Malomo, Eleyinmi, and Fashakin, 2011), however, the sardine powder added destructs the protein gluten network formation (Desai, Brennan, & Brennan, 2018).

Table 4. Mean and Standard Deviation of Noodles Texture as Evaluated by the Trained and Consumer Panelists

Texture	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.70	4.40	3.65	3.20	3.65	3.20
Standard deviation	0.571	0.516	0.933	0.919	0.813	1.14
Interpretation	Liked very much	Liked Very Much	Liked moderately	Liked slightly	Liked moderately	Liked slightly

The texture of food is a sensory attribute correlated with how objects feel when you bite into them, how they look, and the connections between how they feel and how they look (Szczesniak, 2002). Table 6 illustrates the mean acceptability scores for texture of instant noodles made enriched with breadnut and sardine powder. Formulation one (F1), the mean is 4.70 ±0.571 (trained panelist and 4.40 ±0.516 which interpreted as "Like very much" or quality defined as very smooth, while Formulation two (F2) and Formulation three (3) have the same mean average of 3.65 which interpreted as "Liked moderately" or quality define as smooth for texture by trained panelist and "Liked Slightly" by consumer panelists at 3.20 mean average. This implies that the trained panelist varies the panelist prefer Formulation one (F1), which implies that the instant noodle with very smooth texture is mostly acceptable to the panelist. This indicates that the consumers and the trained panelists perceived the texture of the noodles equally in Formulation one but reacted differently on the rest of the formulation. The result show that both trained and consumer panelists have the same evaluation in terms of texture to formulation one, however, at formulation two and three their results contradicted. This implies that the consumers only used the performance criteria listed on the hedonic test survey questionnaire for texture such as (smooth, very smooth) they may not understand the method, or the questions being asked of them, which may lead this can lead to unreliable results (Barton, Hayward, Richardson, McSweeney, 2020), whereas the Trained panelists are well versed in laboratory testing and are considered as being the effective way to create the standard sensory properties of certain products or food items (Ares & Varela, 2017).

Table 5. Mean and Standard Deviation of Noodles Appearance as Evaluated by the Trained Panelists

Appearance	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.75	4.60	3.30	3.20	3.70	3.10
Standard deviation	0.444	0.516	0.801	1.03	0.865	1.10
Interpretation	Liked very much	Liked Very Much	Liked slightly	Liked slightly	Liked moderately	Liked slightly

The noodle appearance is the first comparative measure when determining noodle quality (Hatcher; Symons, Manivannan, 2004). In this study, the noodle appearance being evaluated is its similarity to those noodles that are commercially produced. Food's appearance is assessed in physical variables consist of the geometrical, the food's appearance measurements of scale, shape and inherent characteristic variations of uniformity and density, and the visual, surface gloss or dullness, the quality and degree of pigmentation, and the light-scattering strength of the food's composition (MacDougall, 2003). Table 9 reflects the results mean and standard deviation of noodles appearance as evaluated by the trained and consumer panelists. Formulation one (F1) got the highest mean of 4.75 ±0.444 (trained) and 4.60 ±0.516 (Consumer) which interpreted as "Like very much", followed by Formulation three (F3) with a mean 3.70 ± 0.865 "Liked moderately" and and Formulation three (2) with a mean of

3.20 ±1.03 (consumer), 3.30 ± 0.801 (trained) perceived as "Liked Slightly". The result clearly shows that in Table 4 and Table 5, the firmness and elasticity, food's appearance measurements of scale, characteristic variations of uniformity and density, and the visual evaluation (MacDougall, 2003). This implies that the panelists perceived the formulated breadnut and sardine powder enriched noodles are similar to the commercially manufactured noodles with respect to the appearance.

Table 6. Mean and Standard Deviation of Noodles Color as Evaluated by the Trained and Consumer Panelists

Color	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.55	4.40	3.80	3.70	4.00	3.50
Standard deviation	0.605	0.516	1.11	0.949	1.03	1.18
Interpretation	Liked very much	Liked Very Much	Liked moderately	Liked moderately	Liked moderately	Liked moderately

Food coloration plays an integral part in appearance of food (Corradini, 2019). Originally the noodle mixture is light brown due to the presence of breadnut and sardine In these study 2g of food coloring are added to every formulation to highlight the color difference of every formulation of noodles enriched with breadnut and sardine powder. Based from the mean acceptability scores of the three formulations that Formulation one with 50g breadnut and 25 grams of sardine powder got the highest average mean of 4.40- 4.55 is the liked very much or quality defined as bright yellow in terms of color based on the sensory evaluation of the panel. This agrees to Kovacs, Fowler and Holley (2004) who stated that as with all food products, the quality of the ingredients controls the final result of noodles 325g Allpurpose plus 50grams breadnut and 25g of sardine powder donates brightness level of noodle, the formulation 2 and 3 donates the dark-yellow orange color. This result is related to noodle quality and panelist acceptance.

Table 7. Mean and Standard Deviation of Noodles Aroma as Evaluated by the Trained and Consumer Panelists

Aroma	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.15	3.10	3.30	2.70	3.05	3.00
Standard deviation	0.745	1.29	0.657	0.675	0.826	1.25
Interpretation	Liked moderately	Liked slightly	Liked slightly	Liked slightly	Liked slightly	Liked slightly

Fish odor significantly affects consumer acceptance or rejection. In terms of the perceptibility of breadnut and sardine aroma, the odor of sardines and other fishes are distinctive.One of the major factors impacting the enjoyment or disdain of food is aroma. Table 9 variation in rating of the acceptability of the aroma of noodles enriched with breadnut and sardine powder can be observed. The table shows the mean of each

formulation with respect to Aroma as characteristic of a noodle. For Formulation one (F1) the mean is 4.15± 0.745 having a verbal rating of liked very much or quality define as no odor of sardine, while Formulation two (F2) the mean is 3.30± 0.657 and Formulation three (F3) with a mean of 3.05± 0.826, both formulations have a verbal description of like slightly or quality defined as moderately strong odor and less noticeable by the panel. Thus, makes the Formulation one the most preferred formulation of noodles enriched with 50 grams breadnut and 25 grams sardine powder as evaluated by the panellist. The principle of aromas can be used loosely, since a compound may be pertinent in one form Of product, whereas in another food it may produce a flawed odor or taste, or both, resulting in an off-flavor (Belitz , Grosch , Schieberle, 2004)

Table 8. Mean and Standard Deviation of Noodles Flavor as Evaluated by the Trained and Consumer Panelists

Flavor	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.70	3.70	3.35	3.30	3.30	3.20
Standard deviation	0.571	0.675	0.875	0.483	0.923	1.14
Interpretation	Liked very much	Liked moderately	Liked slightly	Liked slightly	Liked slightly	Liked slightly

When food is consumed, the interaction of taste, odor and textural feeling provides an overall sensation (Belitz, Grosch, Schieberle, 2004). Flavor is the main criterion that makes the product to be liked or disliked (Hussain, S. et al., 2006). As to its mean scores, it can be gleaned from the table that the ratings of the panelists ranged from 3.20 to 4.70. The noodles enriched with 50g breadnut and 25g sardine powder was Liked very much by trained panelists and Like moderately by consumer panelists. Whereas, the noodles enriched with 75-100 g breadnut and 35-50 g sardine powder have similar description light slightly. Flavor results have greater impact from aroma (Belitz, Grosch, Schieberle, 2004).

Table 9. Mean and Standard Deviation of Noodles Palatability as Evaluated by the Trained and Consumer Panelists

Palatability	**Formulation 1**		**Formulation 2**		**Formulation 3**	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Mean	4.35	3.90	3.45	3.50	3.15	3.40
Standard deviation	0.745	0.876	0.999	0.707	0.813	0.966
Interpretation	Liked very much	Liked moderately	Liked moderately	Liked moderately	Liked slightly	Liked moderately

In terms of palatability, Formulation1 (F1) has a general mean of 4.25± 0.745 which was like very much in the verbal descriptive rating. Formulation two (F2) ranks the second having a mean of 3.45 ± 0.999 with a verbal descriptive rating of Like moderately followed by Formulation three (F3) having a mean of 3.15 ± 0.813 with a verbal descriptive rating of like slightly, both have a minimal difference in numerical rating. In this parameter it is observable that the formulation one is the most palatable based on the evaluation of the panel.

Table 10 Trained and Consumer Panelist Preferences among Three Formulations

Attributes	Formulation 1		Formulation 2		Formulation 3	
	Trained	Consumer	Trained	Consumer	Trained	Consumer
Firmness	4.65 ± 0.671	4.60 ± 0.699	3.55 ± 0.945	3.30 ± 0.823	3.55 ± 0.887	2.50 ± 0.972
Elasticity	4.40 ± 0.821	4.80 ± 0.632	3.75 ± 1.21	3.30 ± 0.675	3.65 ± 1.31	2.40 ± 1.17
Texture	4.70 ± 0.571	4.40 ± 0.516	3.65 ± 0.933	3.20 ± 0.919	3.65 ± 0.813	3.20 ± 1.14
Appearance	4.75 ± 0.444	4.60 ± 0.516	3.30 ± 0.801	3.20 ± 1.03	3.70 ± 0.865	3.10 ± 1.10
Color	4.55 ± 0.605	4.40 ± 0.516	3.80 ± 1.11	3.70 ± 0.949	4.00 ± 1.03	3.50 ± 1.18
Aroma	4.15 ± 0.745	3.10 ± 1.29	3.30 ± 0.657	2.70 ± 0.675	3.05 ± 0.826	3.00 ± 1.25
Flavor	4.70 ± 0.571	3.70 ± 0.675	3.35 ± 0.875	3.30 ± 0.483	3.30 ± 0.923	3.20 ± 1.14
Palatability	4.35 ± 0.745	3.90 ± 0.876	3.45 ± 0.999	3.50 ± 0.707	3.15 ± 0.813	3.40 ± 0.966

As the results revealed in Table 12 the formulation one (F1) utilizing 50 grams breadnut powder and 25 grams of sardine powder is the most preferred formulation as perceived by the trained and consumer panelist over the formulation 2 which uses 75 grams breadnut and 35 grams of sardine powder and Formulation 3 comprising 100 grams of breadnut and 50 grams of sardine powder.

Texture: Firmness

Table 12 conveys that in terms of firmness preference, formulation one (F1) is the most preferred formulation of noodles based on the assessment of the panel as it holds shape and not breaking. Firm, elastic, and chewy noodles with high cooking yield and low cooking losses are desirable by consumers (Hou, 2001).

In the study of Oh (1989), the high protein noodles were darker, stronger and more resistant to fracture than low- protein noodles. High protein noodles required longer cooking and gave high cutting stress than low protein noodles. Decreased in firmness happens as protein increases, continuous phase of gluten is required for a dough sheet and requires extra water to disaggregate the flour particles. Liu et al. (2016), revealed that the presence of macronutrients, such as proteins competes with the starch for water, impairs the swelling and gelatinization of starch and thereby decreasing dough hardness and since formulation two and three got the highest amount of breadnut and sardine powder the flour substitution decreases the dough firmness because the protein content of breadnut powder is 3.62% protein of breadnut flour is and 15.70 %

for all purposes of protein which means more all-purpose flour than breadnut flour means high protein content (Malomo, Eleyinmi,.& Fashakin, 2011. Hence, The combination of different flours directly influences the texture of the finished product (Nasiri et al. 2012), which depends mainly on composition, ingredient ratios, and water binding potential (Desai et al. 2018, 2019) at the same time, firmness of noodles depends on the length of cooking time (Jisikyu, 2020) during heating, starch gelatinization and water evaporation led to changes in food structure, increasing the firmness of flour.

Texture: Elasticity

Texture is the paramount concern to consumers of noodle products (Ajila, Aalami, Leelavathi, & Prasada Rao, 2010). Elasticity is the ability of noodles to return to their original thickness after compression. Table 25 and 26 Trained panelist scored formulation one (50 grams breadnut powder and 25 grams of sardine powder) 4.80 or "Liked very much" quality describe as very elastic and can be twirled, folded and resume to its normal state after being stretched and 3.30 or for F2 (75 grams breadnut and 35 grams of sardine powder) and 2.40 or dislike for F3/(100 grams of breadnut and 50 grams of sardine powder). For noodle product, adequate dough strength and extensibility are essential to avoid breaking, breakage and shrinking of the dough layer. Instant noodles, both protein content and volume impact properties such as fat absorption, color and textural quality, as well as dough properties such as water absorption and colour (Gulia, et.al. ,2014). Thus the more breadnut flour and sardine powder substitution the more the elasticity is affected. Variations in gluten properties were found to have significant effects on noodle firmness, elasticity, and smoothness (Baik, 2010)

Appearance and Color

Expectations and real sensory taste and flavor (Wei, Ou, Luo, Hutchings (2012).Food color and presentation are influenced. Studies Oliveira and et al. (2015), reported that , color changes when adding fish flour can be attributed to the visual difference between wheat and fish flours, where fish flour is darker due to the temperature used during the fish pulp drying process while refined wheat flour is white (Mellado-Ortega et al. 2015). Reinforcing these findings, previous studies have confirmed that the substitution of wheat flour with fish flour leads to redness and yellowness values and, therefore, product darkening (Goes et al. 2016; Monteiro et al. 2016; Nurul et al. 2009). Table 12 the Formulation one (50 grams breadnut powder and 25 grams of sardine powder) is rated 4.55 (TP) and 4.40 (CP) or "Liked very much" in quality description bright yellow and looks natural in color, F2 (75 grams breadnut and 35 grams of sardine powder) was rated in mean 3.80 and 3.70 for.40 verbal description of liked moderately and quality defined as dark- yellow- orange color , while for F3(100 grams of breadnut and 50 grams of sardine powder) scored 4.00 (TP) and 3.50 (CP) Liked slightly or quality described as "light brown". Hence, higher starch damage is associated with poor noodle colour, undesirable high cooking loss andexcessive surface swelling (Hatcher et al., 2002).

Aroma

One of the major factors impacting the enjoyment or disdain of such food products is the ingredients of food scent and aroma. Aroma gives multiple associations and thoughts before even food is tasted (Aprea, 2020). Fish odor significantly affects the consumer acceptance or rejection. In terms of the perceptibility of breadnut and sardine aroma, the odor of sardines and other fishes are distinctive, the Formulation one (50 grams breadnut powder and 25 grams of sardine powder) is rated 4.15 (TP) quality defined as no odor or totally no sardine aroma and 3.10 (CP) quality defined as sardine aroma is less noticeable. F2 (75 grams and breadnut and 35 grams of sardine powder) was rated in mean 3.30 (TP) and 2.70 (CP) for verbal description of liked Slightly quality expressed as moderately strong or noticeable, while for F3(100 grams of breadnut and 50 grams of sardine powder) scored 4.00 (TP) and 3.50 (CP) Liked slightly or quality described as "light brown". In this study, the evaluators rated the aroma and flavor differently, higher the fish added the more noticeable and distinctive a noodle and the more they reject it.

Flavor and Palatability

Flavor is the key criterion for product to be desired or not (Hussain, S. et al., 2006). As to its mean scores, it can be gleaned from the table that the ratings of the panelists ranged from 4.70 to 3.30 (TP) and 3.70 to 3.20 (CP). Noodles prepared in 50 grams breadnut powder and 25 grams of sardine powder obtained the highest score. On the other hand, noodles prepared with 100 grams of breadnut and 50 grams of sardine powder documented of the scores of 3.30 and 3.20 by the panelists and described as Like Slightly quality describes as either/ neither good or bad. Meanwhile, palatability may be measured as a subjective food preference, subjective satisfaction or even the quantity of food a subject consumes in grams. The relative palatability of a food can be measured in contrast with other normal ingesters by preferences or taste tests (Stubbs & Blundell,2013). In this study, the evaluators perceived the formulation 1 and Formulation 2 sample as Liked Moderately and the third formulation is perceived as Like slightly mean score ranges from 4.125- 3.275. This implies that the palatability of the product is slightly affected with the presence of breadnut specially fish powder.

Table 11. Mean and Standard Deviation As Perceived By the Trained and Consumer Panelists in Terms of the Attributes

Attributes	**Trained**			**Consumer**		
	Mean	**Interpretation**	**Standard deviation**	**Mean**	**Interpretation**	**Standard deviation**
Firmness	3.92	Liked moderately	0.657	3.47	Liked moderately	0.571
Elasticity	3.93	Liked moderately	0.883	3.50	Liked moderately	0.653
Texture	4.00	Liked moderately	0.612	3.60	Liked moderately	0.734

Appearance	3.92	Liked moderately	0.506	3.63	Liked moderately	0.675
Color	4.12	Liked moderately	0.774	3.87	Liked moderately	0.773
Aroma	3.50	Liked moderately	0.577	2.93	Liked slightly	0.979
Flavor	3.78	Liked moderately	0.695	3.40	Liked moderately	0.562
Palatability	3.65	Liked moderately	0.662	3.60	Liked moderately	0.767

Table 11 presents the mean and standard deviation as perceived by the trained and consumer panelists in terms of the attributes (firmness, elasticity, texture, appearance, color, aroma, flavor, and palatability). It shows that the texture for the trained panelists with mean of 4.00 and standard deviation of 0.506. Color attributes constitute the largest mean for consumer panelists with a mean of 3.87 and a standard deviation of 0.773.

Table 12. T-Test and Wilcoxon Rank Test on Significant Difference among Perception of the Panellist in All Sensory Attributes

Panelists	Trained		Conclusion
	Student's t-statistic	p-value	
Consumer	1.743	0.001	**Significant**

Panelists	Trained		Conclusion
	Wilcoxon W – statistic	p-value	
Consumer	20.1	0.006	**significant**

Based on the Table 10, both the t-test and Wilcoxon rank test shows that there is enough evidence to conclude that there is a significant difference in all sensory attributes of the formulation as perceived by the panelists at 0.05 level of significance.

Table 13. Shelf-life of the most Preferred Formulation: Uncooked

Characteristics	UNCOOKED NOODLES				
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Firmness	**5**	**5**	**5**	**5**	**5**
Elasticity	**5**	**5**	**5**	**5**	**5**
Texture	**5**	**5**	**5**	**5**	**5**
Appearance	**5**	**5**	**5**	**5**	**5**
Color	**5**	**5**	**5**	**5**	**5**
Aroma	**5**	**5**	**5**	**5**	**5**
Flavor	**5**	**5**	**5**	**5**	**5**
Palatability	**5**	**5**	**5**	**5**	**5**

Noodle shelf life can be considerably extended if microbiological and biochemical stability is assured. The easiest way to accomplish this purpose is by drying (Air-drying, deep-frying, or vacuum-drying and oven- drying) the noodle in a moisture content where microbiological development is eliminated (Fu, 2008).Table 27 displays the shelf- life of uncooked noodles that there is no changes in uncooked noodles made

with breadnut and sardine powder day one is the same on day five (5) as to its characteristics (firmness, elasticity, texture, appearance, color, aroma, flavor, and palatability) after five days of observation at room temperature. The shelf life of noodles may be improved by ensuring the correct food-safety requirements. Noodles can be dried by the air drying, deep-frying, and vacuum-drying. Deep-frying is a significant phase in the development of instant noodles, Frozen noodles may be flattened and dried to create highly quality items. Drying methods are categorized as hot-air drying (>70 °C) and non-hot-air drying (<50 °C) depending on the highest temperature used for drying noodles. Since the drying method of noodles requires the use of hot air, it is essential that the product is dried consistently and carefully in order to ensure consistency. Not drying the raw-rice properly could cause over-elongation, splitting and cracking of strands (Fu,2008).

Table 14. Shelf-life of the most Preferred Formulation: Cooked

Characteristics	COOKED NOODLES				
	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Firmness	5	5	2	1	1
Elasticity	5	4	2	1	1
Texture	5	3	2	1	1
Appearance	5	4	2	1	1
Color	5	3	2	1	1
Aroma	5	3	1	1	1
Flavor	5	3	1	1	1
Palatability	5	3	1	1	1

Noodles are usually consumed within one day of the production of noodles due to discoloration and microbial deterioration (Tan & Easa, 2020).The shelf life of cooked noodles can be delayed to 3 to 5 days under refrigeration (Hou, 2001). Table 16 illustrates the shelf-life of the most preferred noodles enrich with breadnut and sardine powder at room temperature. It was observable that the noodles at Day one (1) in all attributes are Like very much, However, on the following day, the firmness of noodles still remains but the rest of the attributes of noodles starts to deteriorate at rating 4 for elasticity and appearance and 3 for color aroma, palatability and flavor. During the third Day the characteristics is more on deteriorating that the researcher starts to disliked the attributes of the noodles. However, shelf life of all these 3 samples was less than day 1. The coliform count increases due to the high-water content and abundant nutrients, specifically during first 24 hr (Ghaffar, Abdulamir, Bakar, Karim, & Saari, 2009; Li et al., 2017). Furthermore, salt extends shelf life of fresh noodles by delaying the oxidative discoloration and spoilage process (Fu, 2008). This showed that the most likely temperature to be used to maintain the and/ or extend shelf life of cooked noodles was refrigerated storage (4 C). This was because this storage temperature was able to delay the growth of microorganism and extended the shelf life of fresh (Tan & Easa, 2020).

Table 15.
Cost Analysis of Noodles Enriched with Breadnut and Sardine Powder

INGREDIENTS	QUANTITY	COST
All-purpose Flour	325 grams	P25.00
Dusting Flour	120 grams	P10.00
Breadnut Flour	50 grams	P5.00
Fish Powder	25 grams	P10.00
Water	200 grams	P 0.00
Salt	10 grams	P0.40
Oil	30 grams	P5.00
Labor Cost (electricity and Gas)		P 25.00
TOTAL COST		P 80.40

Yield: 12 pieces
Sub- Total: P 80.40 /12 (no. of servings/ 50 grams) = P 6.70
Total Cost= P 6.70 (per servings)
Mark Up: 50 %
Price per serving: P 10.00 x12 pieces = P 120.00
Return on Investment (ROI)

$$\text{ROI (\%)} = \frac{\text{Final Value of Investment} - \text{Initial Value of Investment}}{\text{Cost of Investment-}} \times 100\ \%$$

$$\text{ROI (\%)} = \frac{\text{P 120.00} - \text{P 80.40}}{\text{P 80.40}} \times 100\ \%$$

$$\text{ROI (\%)} = \frac{\text{P 39.60}}{80.40} \times 100\ \%$$

ROI (%) = 0.49.25 x 100 %

ROI (%) = 49.25 %

Table 15 shows the benefit-cost analysis per recipe. The total cost of materials and labor sum up to P80.40. While the sales obtain per recipe is P 120.00 with 12 pieces of noodles yield per recipe is at P 10.00 each. The benefit per recipe is 49.25%. Based on the outcome of the cost advantage-analysis, it was concluded that the cost of the commodity is maximized as mass production can be accomplished. As a result, it is feasible that a greater market share will not only be gained in urban but rural areas. For would-be founders, it is profitable since only a minimum start-up capital is needed.

Conclusion

Based on the findings of the study, It is safe to conclude that breadnut (artocarpus camans) and sardine (sardinella longiceps) enriched noodles were acceptable among trained panelist and consumer panelist. The noodles appearance is similar to those that were manufactured commercially. Although there was a slight preference for formulation with 25g sardine powder in terms of aroma over the other formulation

which has 35g and 50g of sardine powder and disliked the elasticity of formulation three. Although sardine powder, due to its distinct smell in a little amount at most 25 grams, can be used as flavoring and seasoning but not as a substitute for flour in making noodles but weakens the gluten formation the dough and affects elasticity. Moreover, the mixture of all-purpose flour and breadnut powder can relate firmness to the noodles but sardine powder should be at minimal percentage because it does not have a pasting capacity and destructs the protein gluten network formation. The noodles are safe with desirable sensory properties at most five days or longer and the ingredients used contains a significant amount of nutrients, making it an ideal raw material for food production. Hence, breadnut and sardines are highly recommended for cultivation, consumption, and commercialization.

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