# Development of Powdered Seasoning from Tuna Bone Scraps With Its Acceptability and Applicability

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## ABSTRACT

This study developed a powdered seasoning from tuna bone scraps and evaluated its sensory acceptability, practical applicability, potential for commercialization, use in selected food products, and microbiological quality. An experimental quantitative design was employed. Tuna bone scraps were cleaned, boiled, extracted, combined with seasoning ingredients, spray-dried with maltodextrin, milled, sieved, and packaged. The pilot-scale formulation reported in the study included 9 kg of tuna bones, garlic, white onion, ginger, laurel leaves, whole peppercorn, salt, and maltodextrin. For the final spray-drying run, 3.721 L of tuna extract was combined with 3.721 L of water and 186 g of maltodextrin and processed at 160 °C for two hours, yielding 368 g of powdered seasoning. A total of 100 evaluators, consisting of 90 Hospitality Management student respondents and 10 experts, assessed the product using structured five-point scales. The seasoning obtained an overall sensory acceptability mean of 4.57, interpreted as Highly Acceptable, and an applicability grand mean of 4.61, interpreted as Highly Applicable. Its potential for commercialization received a mean of 4.60, interpreted as Very High Potential. In selected food applications, the seasoning was evaluated in biscuits, soup, and pasta, with the reported grand mean of 4.57 interpreted as Highly Applicable. Laboratory testing reported Escherichia coli at <1 CFU/g, Salmonella spp. not detected in 25 g, yeast and mold at 10 CFU/g, and aerobic plate count at 260 CFU/g; these results were within the laboratory specifications reported in the study. The histamine result was reported as 1 ppm but requires verification against the original Certificate of Analysis. The findings indicate that tuna bone scraps can be processed into a powdered seasoning with favorable evaluator ratings. Further sensory optimization, nutritional analysis, shelf-life testing, packaging evaluation, economic assessment, and regulatory review are needed before commercial production.

**Keywords:** tuna bone scraps; powdered seasoning; acceptability; applicability; spray drying

## INTRODUCTION

Tuna is an important fishery resource in the Philippines, and tuna processing generates by-products such as bones that may be underutilized despite their potential value. Fish bones have been investigated as food-related raw materials because they may contain minerals and other components of interest. Recent literature has emphasized the valorization of fish-processing side streams as an approach to developing value-added products and supporting more responsible resource use [1–4].

Fish bones and tuna by-products have been studied for food applications, including fish bone powders and ingredients incorporated into cereal-based foods [5–7]. These studies provide a basis for exploring tuna bone scraps as a raw material for a convenient seasoning. However, the nutritional contribution of the finished seasoning cannot be established from the raw material alone and would require compositional analysis of the product.

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Although prior studies have examined fish-derived ingredients, the present study focuses on developing a spray-dried seasoning from tuna bone scraps and evaluating its sensory acceptability, practical applicability, use in selected foods, and reported microbiological results. These evaluations provide an initial assessment of the product under the conditions of the study; they do not establish its nutritional superiority, shelf-life stability, or commercial feasibility.

Powder production requires suitable drying and handling conditions. Spray drying is widely used for converting liquid food materials into stable powders, while maltodextrin may function as a drying aid or carrier that influences powder formation and physical properties [8–10]. For tuna-derived products, microbiological quality is also important because contamination by organisms such as Salmonella spp. and Escherichia coli and the formation of histamine may present food-safety concerns [11].

Consumer acceptance remains important because fish-derived ingredients may contribute a distinctive aroma or flavor. Accordingly, the present study focused on developing a tuna bone powdered seasoning and evaluating its sensory acceptability, practical applicability, potential for commercialization, use in selected food products, and microbiological quality.

### Objective Of The Study

The study aimed to develop a functional powdered seasoning from tuna bone scraps and evaluate its acceptability and applicability. Specifically, it assessed sensory attributes, practical use, potential for commercialization, application in biscuits, soup, and pasta, and selected microbiological parameters.

## METHODOLOGY

### Research Design and Participants

An experimental quantitative research design was used. The study involved 100 evaluators consisting of 90 Hospitality Management student respondents and 10 expert evaluators. Purposive sampling was used to select participants with relevant exposure to food preparation, food processing, cooking, food technology, or powdered seasoning use. The sensory evaluation used a structured five-point Likert scale. Demographic information was summarized using frequency and percentage, while weighted means were used to determine acceptability and applicability.

### Product Development

Tuna bone scraps were obtained from selected suppliers and subjected to cleaning, boiling, extraction, formulation, spray drying, milling, sieving, and packaging. Early trials used dehydrator and convection-oven drying to compare powder characteristics. The first trial produced a strong fish odor and excessive saltiness and used an excessive amount of maltodextrin. The formulation was subsequently adjusted and spray drying was adopted for the final product.

| Ingredient / Material | Final Quantity |
|---|---|
| Tuna bones | 9 kg |
| Garlic | 225 g |
| White onion | 220 g |
| Ginger | 100 g |
| Laurel leaves | 20 g |
| Whole peppercorn | 70 g |
| Salt | 150 g |

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|---|---|
| Maltodextrin | 336 g |

Table 1. Final formulation used in the pilot-scale production.

### Final Processing Conditions

The final recipe reported in the thesis used 3.721 L tuna extract, 3.721 L water, and 186 g maltodextrin for spray drying at 160 °C for two hours, producing 368 g powdered seasoning. The pilot-scale process was reported at 160–180 °C, with extraction and spray-drying stages followed by milling, sieving, and packaging.

### Sensory and Applicability Evaluation

Evaluators assessed the seasoning in terms of taste, aroma, color, texture, and overall acceptability. Applicability was assessed through ease of use, flavor enhancement, and consumer preference. Potential for commercialization was assessed through market potential, uniqueness, and competitiveness. The same product was also incorporated into biscuits, soup, and pasta and evaluated using the study's applicability scale.

### Microbiological Analysis

A laboratory sample of the final powdered seasoning was submitted for testing of Escherichia coli, Salmonella spp., yeast and mold count, aerobic plate count, and histamine. The reported laboratory results were compared with the specifications presented in the thesis.

## RESULTS AND DISCUSSION

### Evaluator Profile

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Age | Below 18 | 0 | 0% |
| | 18–25 | 86 | 86% |
| | 26–35 | 14 | 14% |
| | 36–45 | 0 | 0% |
| | 46 and above | 0 | 0% |
| Sex | Female | 53 | 53% |
| | Male | 41 | 41% |
| | Prefer not to say | 6 | 6% |
| Occupation | HM Students | 90 | 90% |
| | Quality Control | 4 | 4% |
| | Restaurant Personnel | 3 | 3% |
| | Restaurant Manager | 2 | 2% |
| | Chem Tech | 1 | 1% |
| Seasoning use | Daily | 72 | 72% |
| | Weekly | 15 | 15% |

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| | | | |
|---|---|---|---|
| | Sometimes | 13 | 13% |
| | Never | 0 | 0% |

Table 2. Profile of the 100 evaluators.

Most evaluators were 18–25 years old (86%), female (53%), and Hospitality Management students (90%). Most also reported daily use of powdered seasoning (72%). These characteristics indicate that the evaluation was largely informed by young consumers familiar with seasoning products.

**Sensory Acceptability**

| **Sensory Attribute** | **Representative Mean / Grand Result** | **Interpretation** |
|---|---|---|
| Taste | 4.64 | Highly Acceptable |
| Aroma | 4.32–4.56 | Highly Acceptable |
| Color | 4.55–4.60 | Highly Acceptable |
| Texture | 4.61–4.64 | Highly Acceptable |
| Overall acceptability | 4.49–4.72 | Highly Acceptable |
| Grand mean | 4.57 | Highly Acceptable |

Table 3. Summary of sensory acceptability results.

The tuna bone powdered seasoning obtained an overall acceptability grand mean of 4.57, interpreted as Highly Acceptable. The reported item means were also within the Highly Acceptable range. Pleasant aroma had the lowest reported item mean at 4.32, indicating an opportunity for further formulation and process refinement even though the rating remained favorable. The highest reported item mean was 4.72 for potential consumer use and marketability within the overall acceptability section. These findings describe evaluator responses and should not be interpreted as evidence of nutritional superiority or long-term product stability.

**Applicability and Commercial Potential**

| **Indicator** | **Mean** | **Interpretation** |
|---|---|---|
| Ease of use | 4.60–4.71 | Highly Applicable |
| Flavor enhancement | 4.52–4.62 | Highly Applicable |
| Consumer preference | 4.57–4.60 | Highly Applicable |
| Overall applicability | 4.61 | Highly Applicable |
| Potential for commercialization | 4.60 | Very High Potential |

Table 4. Applicability and commercialization results.

The product obtained a grand mean of 4.61 for applicability. Ease of use received favorable ratings, including a reported mean of 4.71 for ease of use in food preparation. Flavor enhancement and consumer preference were also rated highly applicable. The commercialization assessment produced a mean of 4.60, interpreted as Very High Potential. This result reflects the evaluators' perceptions and does not establish commercial feasibility. A

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separate assessment of ingredient and processing costs, labor, utilities, packaging, shelf life, regulatory compliance, and broader consumer demand is still needed.

**Food Application**

| Food Application | Overall Acceptability Mean | Interpretation |
|---|---|---|
| Biscuit | 4.39 | Highly Applicable |
| Soup | 4.41 | Highly Applicable |
| Pasta | 4.60 | Highly Applicable |
| Grand mean | 4.57 | Highly Applicable |

Table 5. Applicability of tuna bone powdered seasoning in selected food products.

The seasoning received favorable ratings in the three food preparations evaluated: biscuits, soup, and pasta. Pasta had the highest reported overall acceptability mean at 4.60, followed by soup at 4.41 and biscuits at 4.39. These results indicate favorable evaluator responses across the tested preparations. Additional trials would be needed to determine the seasoning's performance in other products, including crackers and savory snacks, which were not evaluated in the present study.

**Microbiological Quality**

| Parameter | Method | Specification | Result |
|---|---|---|---|
| Escherichia coli | AOAC 991.14 | <10 CFU/g | <1 CFU/g |
| Salmonella spp. | US FDA BAM Ch. 5 | Not Detected / 25 g | Not Detected / 25 g |
| Yeast and mold | AOAC 997.02 | <100 CFU/g | 10 CFU/g |
| Aerobic plate count | US FDA BAM Ch. 3 | <10,000 CFU/g | 260 CFU/g |
| Histamine | Sensispec Histamine Rapid Kit | Reported in thesis as 1 ppm | 1 ppm |

Table 6. Microbiological testing results reported in the final thesis.

The laboratory results showed low reported counts for Escherichia coli, yeast and mold, and aerobic plate count, while Salmonella spp. was not detected in the tested 25 g sample. The reported results were within the laboratory specifications stated in the thesis for the parameters listed in Table 6. The histamine result was reported as 1 ppm; however, the original Certificate of Analysis must be checked before the value is treated as definitive. These results refer to the tested sample and should not be generalized as proof of overall product safety or stability throughout storage.

**Sensory Evaluation Result**

| Parameter | Test Method | Result |
|---|---|---|
| Appearance | Organoleptic Evaluation | Clumped powder matrix with dry, chalky visual appearance |
| Color (Visual) | Organoleptic Evaluation | Off-white to light cream |
| Taste | Organoleptic Evaluation | Salty with strong fish meat after taste |

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| | | |
|---|---|---|
| Odor | Organoleptic Evaluation | Strong Fishy Aroma |
| Texture | Organoleptic Evaluation | Very fine powder, sticky when rubbed or spread between fingers |

Table 7. Organoleptic Evaluation of the Developed Tuna Bone Powdered Seasoning

The organoleptic evaluation showed that the powdered seasoning had an off-white to light cream color, a dry and clumped appearance, and a fine but slightly sticky texture. It also exhibited a salty taste with a strong fishy aftertaste and aroma. These characteristics may affect the product's acceptability and should be considered in further product improvement.

## CONCLUSION

The study demonstrated that tuna bone scraps can be processed into a powdered seasoning through cleaning, boiling, extraction, spray drying, milling, sieving, and packaging. The final product obtained favorable evaluator ratings, with an overall sensory acceptability grand mean of 4.57. The findings support the feasibility of developing the product at the scale and under the conditions used in this study.

The seasoning obtained a grand mean of 4.61 for practical applicability and a mean of 4.60 for potential for commercialization. The latter reflects evaluator perception rather than confirmed commercial feasibility. Its application in biscuits, soup, and pasta also received favorable ratings. Nutritional composition, shelf-life stability, and commercial-scale feasibility require further evaluation.

The reported microbiological results met the laboratory specifications stated in the thesis for the tested parameters, while the histamine result requires verification against the original Certificate of Analysis. Nutritional composition, shelf-life stability, lipid oxidation, and commercial-scale economics were not established by the present evaluation and should be addressed in future studies.

## RECOMMENDATIONS

1. Refine the formulation and processing conditions to improve aroma and aftertaste while maintaining the favorable sensory attributes observed in the study.

2. Conduct proximate and mineral analyses of the finished seasoning, including moisture, protein, fat, calcium, and phosphorus, before making specific nutritional or functional claims.

3. Evaluate powder stability during storage by monitoring moisture content, water activity, physical changes, and lipid oxidation, and compare suitable moisture- and oxygen-barrier packaging options in a shelf-life study.

4. Verify the reported histamine value using the original laboratory Certificate of Analysis and review applicable food-safety, fish-allergen declaration, and labeling requirements before any commercial release.

5. Conduct additional application trials in products such as crackers or savory snacks. These should be treated as future applications because the present study evaluated biscuits, soup, and pasta.

6. Conduct a detailed production-cost and market assessment that includes ingredients, processing, labor, utilities, packaging, equipment, and broader consumer testing before drawing conclusions about profitability or commercial feasibility.

### Ethical Approval

The study was conducted with due consideration for the rights, privacy, and welfare of the participants. Participation in the study was voluntary, and the participants were informed of the purpose and procedures of

the research prior to data collection. The information gathered from the participants was treated with confidentiality and used solely for the purposes of the study.

**Conflict Of Interest**

The authors declare that there is no conflict of interest related to the conduct, results, or publication of this study.

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