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Musselicious Bildat Kropek: An Input to New Product Development (NPD) of Locally Harvested Bildat (Freshwater Mussel) of Cagayan, Philippines

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ABSTRACT

The aim of this study was to develop and evaluate Bildat Kropek, a snack rich in protein with cultural roots that used powdered Hyriopsis sp. (Bildat), a freshwater mussel found in Cagayan, Philippines. Three different formulations were made, formulation 1 containing (45g powdered bildat), formulation 2 (90g powdered bildat), and formulation 3 (135 powdered bildat). A shrimp kropek available on the market was used as the control. Forty participants utilized a 9-point hedonic scale for evaluating appearance, aroma texture, taste, and overall acceptability. Formulation 1 (45g) was the most preferred, obtaining highest scores in taste (7.80), texture (7.65), and overall acceptability (7.55). Its aroma score (6.85) was comparable to Formulation 3 and the control. Additionally, the proximate analysis of the best formulation (45 g powdered bildat) found that it contains 7.25% protein, 28.23% fat, 0.78% fiber, 5.99% moisture, and 2.62% ash. The nutrition facts based on the result of proximate analysis stated that a 36.6g serving had 185 kcal, 10g of fat, 3g of protein, and 20g of carbohydrates. Moreover, microbial examinations confirmed that the levels of yeast, mold, and coliform were within FDA limits. Bildat Kropek is much healthier and offers competitive sensory appeal compared to commercially available kropek. Additionally, it supports the sustainable use of underutilized freshwater resources.

Keywords: *Acceptability; Bildat; Proximate; Microbial Analysis.*

INTRODUCTION

Kropek is a popular snack, especially in the Southeast Asian region, and primarily known for its light, crispy, and savory taste. The product is usually made from starch with various flavoring agents. This flavorful snack is also valued for its convenience, shelf stability, and nutritional value. The low moisture content of kropek is ideal for longer shelf life. Moreover, recent innovations incorporated seafood into kropek to enhance its nutritional profile (Panganiban et al., 2019).

Furthermore, as consumer awareness of food trends continues to grow, there is a noticeable increase in demand for healthier, more innovative, and sustainable snack options. Incorporating underutilized resources is a great way to sustain these demands. One such resource is Bildat (Hyriopsis sp.), a freshwater mussel found in the Northern Philippines, particularly in the Cagayan River. The clean freshwater ecosystems, low pollution levels, and sandy substrates of the Cagayan River provide an optimal site for the growth of Bildat (Huang et al., 2021; Estrada et al., 2023). Moreover, this freshwater mussel serves as an exceptional supply of proteins, omega-3 fatty acids, vital amino acids, and minerals like vitamin B12, zinc, and magnesium (Swanson et al., 2020).

Despite its nutritional advantages and accessibility, bildat continues not to be utilized in food production. Currently, locals mostly use it in traditional dishes like adobo or sisig. The lack of value-added products indicates that there's a huge opportunity for producing economically beneficial products that align with modern diets, such as halal and vegetarian. Making kropek from Bildat provides consumers with more snack options and supports local aquatic biodiversity, which is in line with the region's cultural identity and environmental protection.

However, existing studies mainly focused on the development and assessment of kropek made from fish, shrimp, and squid, but not much has been done with freshwater mussels like Bildat. There is still insufficient practical information on its sensory properties, how well consumers accept it, how long it lasts on the shelf, and its nutritional value when added to snack foods. This study aims to address these gaps by developing and evaluating Bildat Kropek, a snack that is rich in protein and based on cultural backgrounds, through sensory evaluation, proximate and microbial analysis, and nutritional assessment.

Objectives of the Study

Generally, this study determines the development, acceptability and nutritional content of Bildat Kropek.

Specifically, the researchers would like to answer the following: (1) What is the best formulation based on the level of acceptability in the three formulations in terms of: (1.1) appearance (1.2.) aroma (1.3.) texture (1.4.) taste (1.5.) overall acceptability (2) Is there a significant difference between the three formulations and the control based on acceptability in terms of? (2.1) appearance (2.2) aroma (2.3) texture (2.4) taste (2.5) overall acceptability (3) What is the proximate composition of the developed Bildat Kropek in terms of: (3.1.) Crude Protein (3.2.) Crude Fiber (3.3.) Crude Fat (3.4.) Moisture (3.5.) Ash (4) What is the microbial content of developed Bildat Kropek in terms of: (4.1.) Yeasts and Molds Count (4.2.) Total Coliform Count

MATERIALS AND METHODS

Research Design

This study used a combination of descriptive survey and experimental methods to develop and evaluate Bildat Kropek formulations. Descriptive surveys were used to assess sensory evaluation and the level of acceptability among consumers. Three formulations of Bildat Kropek will be developed using the experimental method.

Sampling Technique

This study utilized purposive sampling, which is an example of a non-probability sampling technique in which participants are selected based on certain criteria that are relevant to the research objectives. The study

involved seven (7) experts from the Food Innovation Center at Cagayan State University (CSU) Carig, ten (10) teachers, and twenty-three (23) students from Cagayan State University Andrews Campus, all of whom specialize in food-related subjects. The participants were selected to evaluate the level of acceptability of Bildat Kropek. It is crucial to include experts, considering their input will help to assess the product's sensory attributes.

Locale of the study

The study on developing Bildat Kropek was conducted at Cagayan State University—Andrews Campus. This campus, in Caritan Sur, Tuguegarao City, Cagayan, serves as a central hub for the academic and administrative operations of CSU and is renowned for its state-of-the-art facilities. The study was done from the month of August 2024 up to the month of June 2025.

Research Instruments

The researchers adapted and utilized a 9-point Hedonic Scale to ensure the respondents provided a reliable and accurate result. Additionally, a comprehensive laboratory analysis of the proximate and microbial content of the sample was undertaken at the Department of Agriculture located at Carig, Tuguegarao City, Cagayan, Philippines.

Data Gathering Procedure

The first step in the production of Bildat Kropek was collecting and cleaning Bildat. Parboiling was done to open the shells of the mussels, then the meat was taken out, together with any black particles, and extra moisture was removed. To eliminate the fishy smell, the meat was boiled again alongside lemongrass, ginger, and bell pepper, then strained and dehydrated for 24 hours. The dried mussel meat underwent a powdering process, and it was added to three different batter recipes. Each formulation used 45g, 90g, and 135g of powdered Bildat, along with rice flour, spices, and water. Each kropek sample was shaped, steamed, dehydrated, and deep-fried.

A sensory evaluation was conducted to assess Bildat Kropek's appearance, aroma, texture, taste, and overall acceptability. Moreover, the accredited lab of the Department of Agriculture employed AOAC and FDA standards to perform proximate analysis (crude protein, fat, moisture, fiber, and ash) and microbial testing (yeast, mold, and coliforms) on the best formulation. Results from proximate analysis serve as a baseline for the development of Bildat Kropek's nutrition facts.

Analysis of the Data/ Statistical treatment

Computed mean scores and standard deviations were used to determine how acceptable each formulation is based on its sensory attributes. A one-way analysis of variance (ANOVA) was employed for each sensory attribute to determine if there were significant differences between the three formulations and the control. The level of significance was set at 0.05. Established laboratory standards were employed to interpret the results of the proximate and microbial analyses. The study utilized AOAC (Association of Official Analytical Chemists) protocols for proximate analysis and FDA (Food and Drug Administration) Circular No. 2022-012 to establish microbial safety limits. These methods guaranteed that the results were interpreted objectively.

RESULTS AND DISCUSSION

Sensory Evaluation

Table 1. Summary of means sensory scores across all formulations

Formulation	Appearance	Aroma	Taste	Texture	Overall Acceptability	Overall Mean
Formulation 1 (45g)	7.50	6.85	7.80	7.65	7.55	7.47
Formulation 2 (90g)	7.03	6.70	7.05	7.33	7.03	7.03
Formulation 3 (135g)	7.05	6.85	7.15	7.08	7.00	7.02
Control (Shrimp)	7.30	6.85	7.38	7.20	7.33	7.21

Formulation 1 (45 g powdered bildat) had the highest mean rating (7.47) across all attributes when all formulations were compared. It shows that this formulation was the most preferred by the panelists. The control (shrimp kropek) was the second highest mean

with an average mean of 7.21, furthermore, Formulations 2 (90 g powdered bildat) and 3 (135 g powdered bildat) had nearly the same sensory means of 7.03 and 7.02, respectively, Additionally, every formulation received a score higher than 7, suggesting that they were generally well-liked.

Significance Testing Using One-Way ANOVA

Table 2. Difference when grouped by type of formulation.

Attribute	F-value	p-value	Decision	Interpretation
Appearance	1.353	0.259	Do not reject Ho	No significant difference
Aroma	0.195	0.899	Do not reject Ho	No significant difference
Taste	0.279	0.082	Do not reject Ho	No significant difference
Texture	1.209	0.308	Do not reject Ho	No significant difference
Overall Acceptability	1.579	0.197	Do not reject Ho	No significant difference
Overall Mean	2.309	0.079	Do not reject Ho	No significant difference

The null hypothesis was not rejected since the p-values for each attribute were higher than 0.05. This indicates that although Formulation 1 had the highest mean ratings, there was no statistically significant difference between the formulations. Subjective responses typically reveal overlapping preferences, which is an expected result in sensory studies (Stone et al., 2020).

Proximate Analysis of Bildat Kropek

The proximate analysis conducted was aligned to AOAC (Association of Official Analytical Chemists) standards. The methods utilized were the ANKOM Filter Bag Technique for crude fat and fiber, the Semi-Automatic Kjeldahl Method for crude protein, and the Gravimetric Methods for moisture and ash content. The accuracy and reliability of the results are ensured by these standard procedures. The table below summarizes the results.

Table 3. Proximate composition of bildat kropek

Component	Percentage (%)
CrudeProtein	7.25
Crude Fiber	0.78
Crude Fat	28.23
Moisture	5.99
Ash	2.62

The result of crude protein indicates that Bildat Kropek contains a moderate amount of protein, with 7.25%. This macro-nutrient is essential for enzyme activity, development of tissues, and metabolic regulation. The protein of 7.25% is higher compared to the commercially available kropek, which normally ranges between 2% and 5% protein depending on the base ingredient (De Guzman et al., 2018). This can be an alternative source of high-protein snacks.

Bildat Kropek has 28.23% crude fat, which is typical of deep-fried products. However, a study by Fellows (2009) stated that the fat content of 28.23% is comparable to commercial kropek, since deep-fried kropek typically contains 25% to 30% fat. Therefore, the reduction of the amount of fat present in the product is suggested to cater health-conscious consumers.

The result shows that the product contains a low fiber content of 0.78% and is still comparable to most commercial kropek, which only contains a very limited amount of fiber because of their formulations that are high in starch (Santos & Reyes, 2019). Therefore, the addition of fiber-rich ingredients is recommended to improve its nutritional profile.

A dry, crunchy-textured, long-shelf-life product is characterized by having a low moisture content. A moisture content of 5.99% in Bildat Kropek is considered low and acceptable within the allowable range of 2% to 6.5% for fried snack products based on Codex Alimentarius standards. This range is excellent for ensuring product crispiness, microbial stability, and a longer lifespan.

The ash content of 2.62% suggests there's a presence of essential minerals, although specific minerals were not identified on proximate analysis. However, a study done by Venugopal & Gopakumar (2017) found that mussel-based products are usually rich in minerals such as calcium, phosphorus, and magnesium, adding nutritional value to the snack.

Nutrition Facts Panel Analysis based on Proximate Analysis

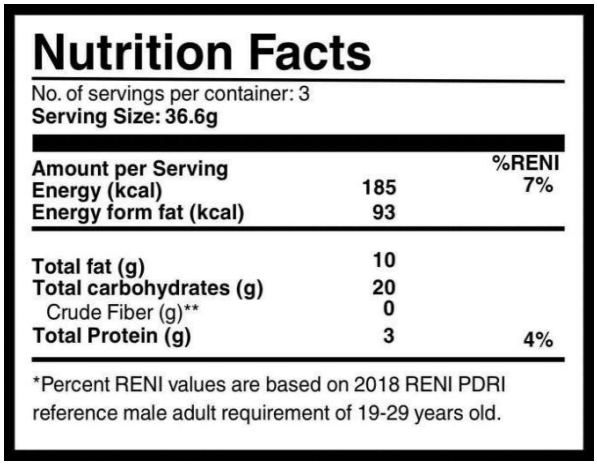


Fig. 1. Nutrition facts of bildat kropek

The Bildat Kropek's nutritional label was based on the result of its proximate analysis. The entire package renders around three servings, with a standard serving size of 36.6 grams. Each serving has 185 kcal of energy per serving, and 93 kcal was from fat. Ten (10) grams of total fat, twenty grams of carbohydrates, and three grams of protein were present in each serving. These values were consistent with the proximate results that were previously discussed. According to the 2018 PDRI guidelines, the protein level provides 4% of the Recommended Energy and Nutrient Intake (RENI) for adults aged 19 to 29. The current formulation's inability to offer digestive benefits is demonstrated by the lack of dietary fiber.

Microbial Analysis of Bildat Kropek

The purpose of the microbiological analysis of Bildat Kropek was to identify whether it complied with the requirements for food safety and whether it was ideal to be consumed as a prepackaged snack food product. The Nissui Compact Dry method was used for the analysis, and the microbial limits set in FDA Circular No. 2022-012 for Philippine processed food products were used to interpret the results. Yeasts, molds and coliforms were among the parameters that were tested.

Table 4. Microbial Analysis of bildat kropek

Microbial Parameter	Result (CFU/g)	FDA Acceptable Limit (Snack Foods)	Interpretation
Yeasts	<1 × 10	≤10	Compliant; no visible yeast-like fungi growth
Molds	<1 × 10	≤10	Compliant; the product is free of mold contamination
Total Coliforms	<1 × 10	≤10	Compliant; no coliform contamination detected

The microbiological profile of the Bildat Kropek showed favorable results for three microbial parameters.

The levels of molds and the yeast in the sample were both less than 1 × 10 CFU/g, which is significantly lower than the FDA Circular No. 2022-012 maximum acceptable level of 10 CFU/g. The study by Soriano et al. (2017), who highlighted the importance of drying temperature and packaging in preventing fungal growth in seafood-based snacks, indicates the product was manufactured under hygienic conditions that prevented microbial contamination.

Furthermore, total coliforms were detected to be in the range of less than 10 CFU/g, indicating that the product was handled with clean water and equipment and stored in a hygienic environment. Coliforms must be completely absent in food and water products to ensure safe consumption (U.S. EPA, 2022; WHO, 2017). Similar findings have been identified in Dizon and Mercado's (2019) research, which revealed that seafood crackers processed using better sanitation procedures produced results free of coliform.

CONCLUSIONS

The main aim of the study was to develop and evaluate the acceptability, nutritional and microbial composition of Bildat kropek.

The sensory evaluation findings, stated that all formulations obtained a favorable mean scores;

however, Formulation 1 (45g Bildat) sensory scores achieved superior to the others in terms of overall acceptability (7.55), taste (7.80), texture (7.65), and appearance (7.50) while its aroma score (6.85) was comparable to both the control and Formulations 2 and 3. Consumers clearly preferred Formulation 1, even though statistical tests revealed no significant differences among samples ($p > 0.05$).

The nutritional composition of the best formulation (formulation 1) determined by proximate analysis, was 7.25% crude protein, 28.23% fat, 0.78% fiber, 5.99% moisture, and 2.62% ash. This indicates a moderate source of protein with a high fat content, which is typical of deep-fried snacks, and traces of minerals that are essential for maintaining good health. Nutritionally, the kropek provides 185 k cal per 36.6g serving, with 10g of fat, 3g of protein, and 20g of carbohydrates—accounting for approximately 4% of the RENI for protein in young adults.

Lastly, the Bildat Kropek adhered with safety standards for three microbial parameters (mold, coliform, and yeast) and all were below the detectable limits ($<1 \times 10$ CFU/g).

The results highlighted the potential of Bildat Kropek as a locally made snack. Its promising sensory appeal, nutritional value and economic impact signifies its importance as a community-based product. The incorporation of underutilized aquatic resources into a value-added product offers not only nutritious snack options but also helps food security and sustainability. This study also determines the areas for improvement specifically in improving cooking processes to ensure its compliance with food safety.

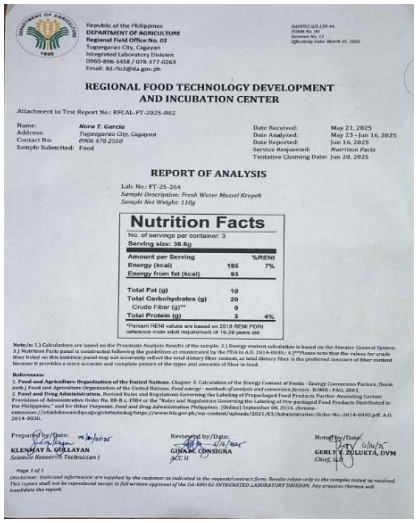
Bildat Kropek was an input to a new product development. This is an innovative snack made from mussels that combines traditional culinary culture with modern day dietary needs. This study contributes to the limited information and literature regarding the use of freshwater mussels in the development of value-added products and encourages further exploration for the enhancement of formulations, prolonging shelf life and expanding industry application. The data obtained from this study serves as a basis for integrating local resources into innovative, beneficial and culturally rooted food products.

RECOMMENDATIONS

The following suggestions are designed to improve the product's development, safety, and sustainability: (1) For future researchers, explore the addition of fiber-rich ingredients like taro, potatoes, legumes, and other whole grains to improve the nutritional profile of the product. Additionally, it is recommended to conduct studies with a larger sample size to provide results that are more reliable. (2) For students and academic institutions, particularly those in food science, vocational education, and fisheries, this study may serve as a basis for exploring innovative product development using indigenous aquatic resources. Experimental modifications in preparation methods—such as air-frying or oven-baking—may be explored to reduce fat content while maintaining crispness. (3) For government agencies, such as the Department of Environment and Natural Resources (DENR), Bureau of Fisheries and Aquatic Resources (BFAR), and Department of Science and Technology (DOST), a scientific ecological examination of BIldat (Hyriopsis sp.) populations in Cagayan is recommended. This will help determine the sustainability for harvesting and support conservation efforts aligned with community-based resource management. (4) For local cooperatives and communities of Cagayan, the development and implementation of livelihood programs focused on mussel harvesting and production are suggested. Comprehensive and adequate training in food safety, drying techniques, and food processing should be facilitated to maximize economic advantages while conserving aquatic ecosystems.

Appendix A. Bildat Kropek

Appendix B. Nutrition Facts of Bildat Kropek



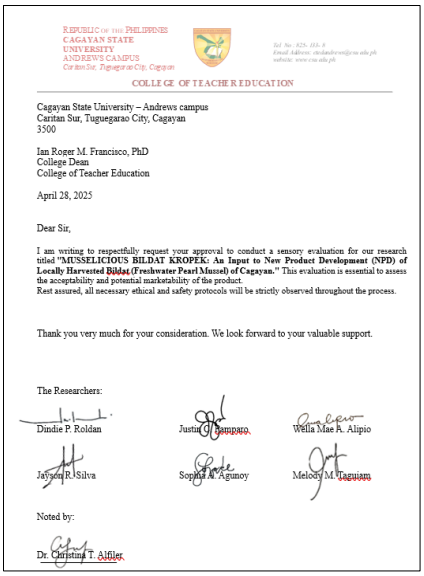
REGIONAL FOOD TECHNOLOGY DEVELOPMENT AND INCUBATION CENTER

REPORT OF ANALYSIS

Nutrition Facts

Amount per Serving	%RENI
Energy (kcal) 185	7%
Energy from fat (kcal) 93	
Total Fat (g) 10	
Total Carbohydrates (g) 20	
Crude Fiber (g)** 0	
Total Protein (g) 3	4%

Appendix C. Letter to the Dean Request for Sensory Evaluation Approval



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3500

Ian Roger M. Francisco, PhD
College Dean
College of Teacher Education

April 28, 2025

Dear Sir,

I am writing to respectfully request your approval to conduct a sensory evaluation for our research titled **"MUSSELICIOUS BILDAT KROPEK: An Input to New Product Development (NPD) of Locally Harvested Bildat (Freshwater Pearl Mussel) of Cagayan."** This evaluation is essential to assess the acceptability and potential marketability of the product.
Rest assured, all necessary ethical and safety protocols will be strictly observed throughout the process.

Thank you very much for your consideration. We look forward to your valuable support.

The Researchers:

Dindie P. Roldan — Justin G. Tamparo — Wella Mae A. Alipio
Jayson R. Silva — Sophia M. Agunoy — Melody M. Taguiam

Noted by:

Dr. Christina T. Alfiler

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