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Nutrient-Enriched Kropek: A Malunggay- Alugbati Acceptability, Sensory Evaluation and Nutritional Analysis

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ABSTRACT

This study focused on creating a nutrient-rich kropek by adding Malunggay (Moringa oleifera) and Alugbati (Basella alba) leaves. We also looked at how it tastes and how nutritious it is. We prepared four different recipes with varying amounts of Malunggay and Alugbati. Then, we asked 50 people to taste and rate them using a 9-point scale to see which ones they liked the most. We looked at several qualities like appearance, smell, taste, texture, and whether people generally liked it. The results showed clear differences among the different recipes in all these areas ($p < 0.001$). Interestingly, Formulation 2, which used 70% Malunggay and 30% Alugbati, scored the highest in how good it tasted (7.65), how nice it felt to eat (7.88), and how much people liked it overall (7.65). It looked at the best formulation, it turned out to have about 27.97 grams of crude fat per 100 grams, along with 1.80 grams of crude protein and only 2.40 grams of moisture. This shows that it's possible to make a snack that's not only more in tune with local tastes but also a healthier option by using leafy greens from the community. The study points out that Malunggay-Alugbati kropek has real potential for commercial growth and could be improved even further in terms of nutrition.

Keywords: *Nutrient Enriched Kropek; Malunggay (Moringa oleifera); Alugbati (Basella alba); Proximate Analysis; Local Food Innovation; Healthier Snack*

INTRODUCTION

Objectives of the Study

To evaluate the sensory attributes of Malunggay-Alugbati kropek, specifically its aroma, appearance, taste, and texture. It also aims to determine the snack's overall acceptability based on sensory evaluation. Additionally, the study seeks to analyze the proximate nutritional content of the kropek, focusing on moisture, crude protein, and crude fat levels. Lastly, it intends to assess whether there are significant differences in the sensory characteristics of the kropek depending on the type of mixture used in its formulation.

MATERIALS AND METHODS

Research Design

In order to learn more about how individuals perceive Malunggay-Alugbati kropek, this study used a descriptive experimental method, focusing on its formulation and consumer perceptions. This method makes it easier to get organized data on respondents' preferences and thoughts about the product. Sensory evaluations and acceptability were conducted using 9-hedonic rating scales, which assessed qualities such as taste, texture, aroma, and appearance. The researchers are set to find out what the respondents liked and how each sensory component affected their overall enjoyment of the kropek in order to optimize the product composition based on customer feedback. Formulation 1 to 4 was conducted to determine the best formulation and to improve the product in terms of its sensory qualities. The formulas were based on the control recipe. Each formulation varies measurements in terms of malunggay and alugbati leaves.

Sampling Technique

Random sampling will be utilized to identify the participants who will form part of the target population at the CTED. The technique is effective in ensuring equal probability for all selected participants.

Locale of the study

The study was conducted at Cagayan State University Andrews Campus in the college of Teacher Education (CTED), and the product preparation/formulation is in Caritan Centro, Tuguegarao City, while the sensory and level of acceptability will be conducted in the Food Innovation center and CTE classrooms.

Research Instruments

To get the appropriate data that the study needs, the researchers administered a printed questionnaire that the respondents will answer right after tasting each treatment. This tool determined the best formulation and sensory evaluation of Malunggay-Alugbati kropek among the 50 respondents. The tool that was used is the 9-point Hedonic Scale, in which the participants rated the Malunggay-Alugbati kropek from 9 as the highest to 1 as the lowest according to how much they liked the product. On the other hand, the participants were asked to accomplish part two by eliciting recommendations and suggestions to improve the product further.

Data Gathering Procedure

The weighted mean will be used to assess the Formulation and Sensory Evaluation of the product in terms of appearance, aroma, flavor, texture, and the best formulation using the Hedonic Scale with “9” equaling to “Like extremely” and “1” equaling to “Dislike Extremely”.

Analysis of the Data/ Statistical treatment

The weighted mean will be used to assess the Sensory Acceptability of the product in terms of appearance, aroma, flavor, texture, and the best formulation using the Hedonic Scale with “9” equaling to “Like extremely” and “1” equaling to “Dislike Extremely”.

Scale Value	Descriptive Scale	Mean Range
9	Like Extremely	8.12- 9.00
8	Like Very Much	7.23- 8.11
7	Like Moderately	6.34- 7.22
6	Like Slightly	5.45- 6.33
5	Neither Like or Dislike	4.56- 5.44
4	Dislike Slightly	3.67- 4.55
3	Dislike Moderately	2.78- 3.66
2	Dislike Very Much	1.89- 2.77
1	Dislike Extremely	1.88

The data obtained from the sensory evaluation will be subjected to statistical analysis, specifically ANOVA at a 5

% level of significance, to determine whether there is a significant difference among the formulation.

RESULTS AND DISCUSSION

Table 1. Sensory Attributes and Overall Acceptability of Malunggay- Alugbati kropek

Formulation	Appearance	Aroma	Taste	Texture	Overall Acceptability	Mean
F1	6.02	6.06	6.14	6.25	6.25	6.15
F2	6.06	7.39	7.65	7.88	7.65	7.56
F3	7.29	7.10	6.98	7.33	6.26	7.21
F4	6.55	6.22	6.13	6.24	6.26	6.28

Table 1 presents the sensory evaluation focused on four key attributes which include appearance, aroma, taste, texture, and overall acceptability. Each formulation was rated using a hedonic scale. The appearance acceptability ratings of the four malunggay-alugbati kropek formulations, as evaluated by the sensory evaluators using a 9-point hedonic scale, showed that F3 received the highest score at 7.29 ("Like Very Much"), followed by F4 with a score of 6.55 ("Like Moderately"). These formulations are rated approximately 6.02 and 6.06 on comparison of their performance (F1 and F2). They were not as good-looking as some of the others (that's why they scored just above the "Like Slightly" threshold). When it came to taste, though, F2 really stood out, earning the highest score of 7.65, which means people liked it very much. F3 wasn't far behind with a 6.98 ('Like Moderately'), while F1 and F4 lagged a bit, each getting around 6.14 and 6.13 ('Like Slightly'). For texture, F2 again came out on top with a score of 7.88 ('Like Very Much'), and F3 also did well with a 7.33. On the other hand, F1 and F4 received lower scores—6.25 and 6.24 respectively—meaning they were only slightly liked in terms of feel. As for aroma, F2 held on to the lead with a 7.39, making it clear that people truly valued its well-rounded aroma, flavor and crispness. F3 followed with a 7.10 and the next highest-scored was F1 and F4 with approximately 6.22 and 6.06, respectively, meaning the aroma was only minimally liked by the evaluators.

The overall acceptability, formulation 2 (F2) was found to have consistently higher scores for most sensory attributes, and the highest overall mean acceptability score of 7.56 (like very much). Formulation 3 (F3) performed best overall with a mean of 7.21 ("Like Very Much"). Formulation 1 (F1) and F4 each had overall acceptability means of 6.15 and 6.28 respectively, both in the "Like Slightly" territory.

Table 2. Mean of Sensory Attributes per formulation

Appearance	**Formulation**	**Mean**
	Formulation 1	6.00
	Formulation 2	7.25
	Formulation 3	7.29
	Formulation 4	6.55
Total		**6.77**
Aroma	**Formulation**	**Mean**
	Formulation 1	6.06
	Formulation 2	7.39
	Formulation 3	7.10
	Formulation 4	6.22
Total		**6.69**
Texture	Formulation	Mean
	Formulation 1	6.14
	Formulation 2	7.65
	Formulation 3	6.98
	Formulation 4	6.14
Total		**6.73**
Taste	**Formulation**	**Mean**
	Formulation 1	6.25
	Formulation 2	7.88
	Formulation 3	7.33
	Formulation 4	6.24
Total		6.93
Overall acceptability	**Formulation**	**Mean**
	Formulation 1	6.25
	Formulation 2	7.65
	Formulation 3	7.33
	Formulation 4	6.26
Total		6.88

In table 2, the mean score indicates that Formulations 2 and 3 got higher mean scores for appearance, thus being rated better visually than Formulations 1 and 4, with an overall moderate appearance rating of 6.77 across all formulations. Formulation 2 possessed the highest aroma score, and Formulation 3 was second closest, thus indicating that these two have the most appealing or intense aroma, whereas Formulations 1 and 4 scored less and therefore are indicated as less preferred aromas. The overall aroma rating was moderate at 6.69. With regard to the texture, Formulation 2 was the highest again, and thus the most desirable texture, whereas Formulations 1 and 4 shared the lowest scores, with a total mean texture rating of 6.73. For taste, Formulation 2 was the most preferred and flavorful,

followed by Formulation 3, while Formulations 1 and 4 had similar, lower scores; the overall taste quality was moderately good with a mean of 6.93. Finally, Formulation 2 attained the highest overall acceptability rating, thus reflecting its strong performance across all sensory attributes. Formulation 3 also scored well. Formulations 1 and 4 had lower overall acceptability scores, and the total mean of 6.88 indicates a moderate general acceptance of all products.

Based on the sensory evaluation data for appearance, aroma, texture, taste, and overall acceptability, Formulation 2 consistently achieved the highest scores across all attributes, indicating it is the most preferred and well-balanced product among the four. Formulation 3 also performed well, particularly in appearance, aroma, taste, and overall acceptability, making it a strong alternative to Formulation 2. In contrast, Formulations 1 and 4 scored lower across all sensory parameters, suggesting they are less favored by evaluators. The overall mean scores for all formulations reflect moderate acceptance, with values ranging from approximately 6.7 to 6.9, indicating that while the products are generally acceptable, there is room for improvement. These results suggest that Formulation 2 is likely to have the highest consumer appeal, followed by Formulation 3, while Formulations 1 and 4 may benefit from further refinement to enhance their sensory qualities and market potential. This insight can guide future product development and optimization efforts.

These results suggest that Formulation 2 is likely to have the highest consumer preference, followed by Formulation 3, while Formulations 1 and 4 might still be able to modify their sensory characteristics and market prospects. This information can direct the next step of product development and improvement.

Table 3. Nutritional Analysis of Malunggay-Alugbati Kropek

Sample Code	Sample Description	Parameter	Result
Che-0595	Malunggay-Alugbati Kropek	Crude fat(g/100g)	27.97
		Crude Protein(g/100g)	1.8
		Moisture(g/100g)	2.4

A proximate analysis was conducted on sample code Che-0595 (Malunggay-Alugbati Kropek) which reveals the following key nutritional components:

Crude Fat: 27.97 g/100g

This reflects a relatively high fat content, which is expected due to the product's deep-fried nature. The fat contributes to its crunchy texture and rich flavor, but it also suggests that health-conscious consumers may want to be mindful of its caloric density.

Crude Protein: 1.80 g/100g

The protein content is modest, likely sourced from the malunggay and alugbati leaves, both known for their nutritional value. There is room to enhance the protein level by incorporating legume flour or other plant-based proteins.

Moisture: 2.40 g/100g

A low moisture content is ideal for kropek because it results in a dry and crisp product. This also helps extend shelf life by reducing the likelihood of mold or spoilage.

Table 4. ANOVA Result

		Sum of Squares	df	Mean of Square	F	Sig.
Appearance	**Between groups**	58.725	3	19.575	18.389	.000
	Within Groups	212.902	200	1.065		
	Total	271.627				
Aroma	**Between groups**	65.426	3	21.809	19.816	.000
	Within Groups	220.118	200	1.101		
	Total	285.544	203			
Texture	**Between groups**	1.922	3	27.307	18.658	.000
	Within Groups	292.706	200	1.464		
	Total	374.627	203			
Taste	**Between groups**	102.407	3	34.136	20.350	.000
	Within Groups	335.490	200	1.677		
	Total	437.897	203			
Overall Acceptability	**Between groups**	79.635	3	26.545	19.689	.000
	Within Groups	268.287	199	1.348		
	Total	347.921	202			

Table 5. **Multiple Comparisons**

95% Confidence Interval							
Dependent Variable	(I)Formulation	(J) Formulation	Mean Difference(I-J)	Std Error	Sig.	Lower Bound	Upper Bound
Appearance	1	2	-1.255*	.204	.000	-1.66	-.85
		3	-1.294*	.204	.000	-1.70	-.89
		4	-.549*	.204	.008	-.95	-.15
	2	1	1.255*	.204	.000	.85	1.66
		3	-.039	.204	.848	-.44	.36
		4	.706*	.204	.001	.30	1,11
	3	1	1.294*	.204	.000	.89	1.70
		2	.039	.204	.848	-.36	.44
		4	.745*	.204	.000	.34	1.15
	4	1	.549*	.204	.008	.15	.95
		2	-.706*	.204	.001	-1.11	-.30
		3	-.745*	.204	.000	-1.15	-.34
Aroma	1	2	-1.333*	.208	.000	-1.74	-.92
		3	-1.039*	.208	.000	-1.54	-.63
		4	-.157	.208	.451	-.57	.25
	2	1	1.333*	.208	.000	.92	1.74
		3	.294	.208	.158	-.12	.70
		4	1.176*	.208	.000	.77	1.59
	3	1	1.039*	.208	.000	.63	1.45
		2	-.294	.208	-.70	-.70	.12
		4	.882*	.208	.47	.47	1.29
	4	1	.157	.208	.451	-.25	.57
		2	-1.176*	.208	.000	-1.59	-.77
		3	-.882*	.208	.000	-1.29	-.47
Texture	1	2	-1.510*	.240	.000	-1.98	-1.04
		3	-.843	.240	.001	-1.32	-.37
		4	.000	.240	1.000	-.47	.47
	2	1	1.510*	.240	.000	1.04	1.98
		3	.667*	.240	.006	.19	1.14
		4	1.510*	.240	.000	1.04	1.98
	3	1	.843*	.240	.001	.37	1.32
		2	-.667*	.240	.006	-1.14	-.19
		4	.843*	.240	.001	.37	1.32
	4	1	.000	.240	1.000	-.47	.47
		2	-1.510*	.240	.000	-1.98	-1.04
		3	-.843*	.240	.001	-1.32	-.37
Taste	1	2	-1.627*	.256	.000	-2.13	-1.12
		3	-1.078*	.256	.000	-1.58	-.57
		4	.020	.256	.939	-.49	.53
	2	1	1.627*	.256	.000	1.12	2.13
		3	.549*	.256	.034	.04	1.05
		4	1.647*	.256	.000	1.14	2.15
	3	1	1.078*	.256	.000	.57	1.58
		2	-.549*	.256	.034	-1.05	-.04
		4	1.098	.256	.000	.59	1.60
	4	1	-.020	.256	.939	-.53	.49
		2	-1.647*	.256	.000	-2.15	-1.14
		3	-1.098*	.256	.000	-1.60	-.59
Overall Acceptability	1	2	-1.392*	.230	.000	-1.85	-.94
		3	-1.078*	.230	.000	-1.53	-.63
		4	-.005	.231	.982	-.46	.45
	2	1	1.392*	.230	.000	.94	1.85
		3	.314	.230	.174	-.14	.77
		4	1.387*	.231	.000	.93	1.84
	3	1	1.078*	.230	.000	.63	1.53
		2	-.314	.230	.174	-.77	.14
		4	1.073*	.231	.000	.62	1.53
	4	1	.005	.231	.982	-.45	.46
		2	-1.387*	.231	.000	-1.84	-.93
		3	-1.073*	.231	.000	-1.53	-.62

The mean difference is significant at the 0.05 level

ANOVA interpretation

The outcomes of the one-way ANOVA showed that there were significant differences among the four batches of kropek in all the sensory attributes tested, namely appearance, aroma, texture, taste, and overall acceptability ($p < 0.001$ for all). These observations clearly indicate that the nature and the quantity of Malunggay and Alugbati that were applied to each recipe had a significant effect on the quality of the product as perceived by consumers. The highest F-value was found for taste ($F = 20.350$), followed closely by overall acceptability ($F = 19.689$), which means that these attributes were the most affected by the formulation differences. Also, the data, which are consistently significant across all attributes, further support the assertion that the formulation is a key factor in both the sensory and the appeal of the kropek products.

Lsd Pairwise Comparison Interpretation

As for the appearance scores, the results shown Formulations 2 and 3 had the highest appearance rating and the associated ratings are statistically similar as well, so there were no significant differences between them. Formulation 1 received a significantly lower appearance score than all other formulations, so it was rated as the least preferred. Formulation 4 had moderate overall appearance (significantly better than Formulation 1, but significantly worse than Formulations 2 and 3). Taken together, Formulations 2 and 3 most desirable in sight and Formulation 1 is less desirable in sight.

In Aroma formulation 1 scored significantly lower in aroma compared to Formulations 2 (-1.333) and 3 (-1.039), indicating it was less preferred for aroma. There was no significant difference between Formulations 1 and 4. Formulation 4 scored significantly lower than Formulations 2 and 3, which were rated highest and not significantly different from each other. This suggests that Formulations 2 and 3 have the most appealing aroma, while Formulation 1 is the least favored in this attribute.

In Texture formulation 1 had significantly lower texture ratings than Formulations 2 (-1.510) and 3 (-0.843) but was not different from Formulation 4. Formulations 2 and 3

scored significantly higher than Formulation 4, with Formulation 2 having the highest texture rating overall. Formulation 4's texture was similar to Formulation 1 but lower than 2 and 3. This means Formulations 2 and 3 have the best texture, while Formulation 1 and 4 are less preferred.

In Taste Formulation 1 was rated significantly lower in taste compared to Formulations 2 (-1.627) and 3 (-1.078), with no significant difference from Formulation 4. Formulation 4 scored significantly lower than Formulations 2 and 3. Formulations 2 and 3 scored highest in taste, with Formulation 2 slightly preferred over 3. Overall, Formulations 2 and 3 are most liked for taste, while Formulations 1 and 4 are less favored.

When it comes to overall acceptability, Formulation 1 really didn't make the cut compared to Formulations 2 and 3, scoring a notable -1.392 and -1.078 lower, respectively. Interestingly, there wasn't much difference between Formulation 1 and Formulation 4, but Formulation 4 did fall short compared to the other two. It turns out that Formulations 2 and 3 were the clear favorites, rated highest and similarly in terms of acceptability. So, it seems like everyone prefers Formulations 2 and 3, while Formulations 1 and 4 are just not hitting the mark.

Looking at the one-way ANOVA results, we can see some significant differences among the four kropek formulations in all sensory attributes think appearance, aroma, texture, taste, and overall acceptability ($p < 0.001$). Formulation 2 was the standout performer, consistently earning the top scores across all sensory aspects and overall acceptability. Formulation 3 came in a close second, with no significant difference from Formulation 2 in terms of overall acceptability. On the flip side, Formulations 1 and 4 lagged behind, particularly in aroma and texture, suggesting there's definitely room for improvement there. All in all, these findings highlight Formulation 2 as the best candidate for further development or even commercial release, with Formulation 3 being a solid backup option.

RECOMMENDATIONS

(1) Since consumers prefer the taste of Formulation 2, we will proceed with it. (2) To enhance its nutritional profile, consider adding high-protein ingredients such as soybean flour, mung bean flour, or other plant-based proteins. (3) To make it healthier, reduce the fat content and cook it using such methods as air-frying or baking rather than traditional frying; this may allow for a lower-fat version. (4) Additional studies This could include shelf-life trials and larger-scale market tests to determine how it performs in real-world conditions and how consumers react over time.

In our research, we found out that making kropek with malunggay and alugbati is possible and people actually liked it. It also has the chance to be healthier than regular kropek. If it gets more improvements and better equipment, this kind of kropek can be a good choice for a new snack in the future.

Appendices

Appendix A. Research Instrument

Sensory Evaluation Form

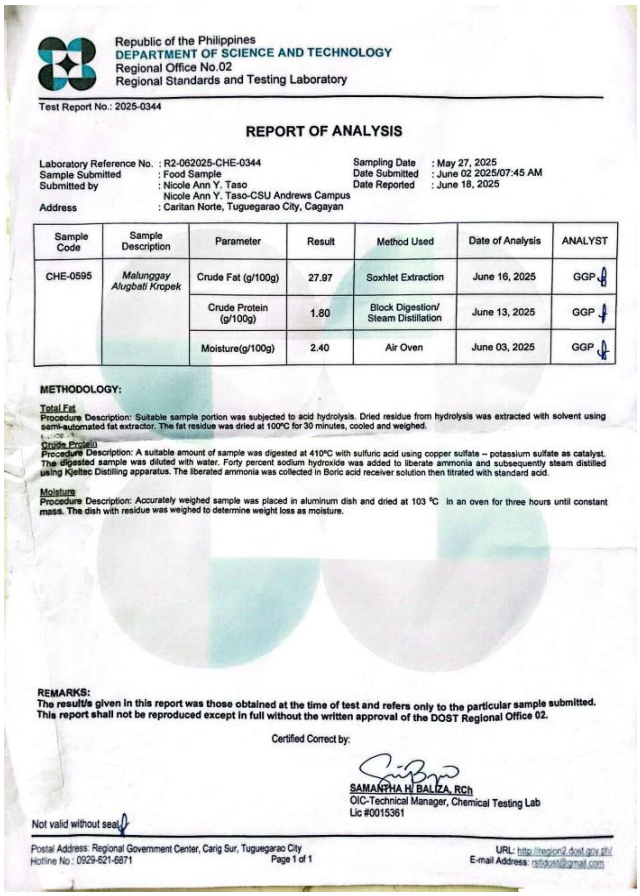
Name:(Optional) _____**Date:** _____

Dear Respondents: Using the hedonic scale below, rate the best formulation of the Nutrient-Enrich Kropek: A Malunggay Alugbati Acceptability, Sensory Evaluation and Nutritional Analysis with the following questions by putting a check in the box. Please answer honestly. Don't leave an item unanswered.

9- Like Extremely	6- Like slightly	3- Dislike moderately
8- Like very much	5- Neither like nor dislike	2- Dislike Very Much
7- Like moderately	4- Dislike slightly	1- Dislike extremely

Comments and suggestions for further improvement of the product.

Appendix B. Laboratory Result



Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY
Regional Office No.02
Regional Standards and Testing Laboratory

Test Report No.: 2025-0344

REPORT OF ANALYSIS

Laboratory Reference No. : R2-062025-CHE-0344
Sample Submitted : Food Sample
Submitted by : Nicole Ann Y. Taso
Nicole Ann Y. Taso-CSU Andrews Campus
Address : Caritan Norte, Tuguegarao City, Cagayan
Sampling Date : May 27, 2025
Date Submitted : June 02 2025/07:45 AM
Date Reported : June 18, 2025

Sample Code	Sample Description	Parameter	Result	Method Used	Date of Analysis	ANALYST
CHE-0595	*Malunggay Alugbati Kropek*	Crude Fat (g/100g)	27.97	Soxhlet Extraction	June 16, 2025	GGP
		Crude Protein (g/100g)	1.80	Block Digestion/ Steam Distillation	June 13, 2025	GGP
		Moisture(g/100g)	2.40	Air Oven	June 03, 2025	GGP

METHODOLOGY:

Total Fat
Procedure Description: Suitable sample portion was subjected to acid hydrolysis. Dried residue from hydrolysis was extracted with solvent using semi-automated fat extractor. The fat residue was dried at 100ºC for 30 minutes, cooled and weighed.

Crude Protein
Procedure Description: A suitable amount of sample was digested at 410ºC with sulfuric acid using copper sulfate – potassium sulfate as catalyst. The digested sample was diluted with water. Forty percent sodium hydroxide was added to liberate ammonia and subsequently steam distilled using Kjeltec Distilling apparatus. The liberated ammonia was collected in Boric acid receiver solution then titrated with standard acid.

Moisture
Procedure Description: Accurately weighed sample was placed in aluminum dish and dried at 103 ºC in an oven for three hours until constant mass. The dish with residue was weighed to determine weight loss as moisture.

REMARKS:
The result/s given in this report was those obtained at the time of test and refers only to the particular sample submitted.
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OIC-Technical Manager, Chemical Testing Lab
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