Development of Eggplant-Based Edible Sheets for Food Applications: Formulation and Characterization

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ABSTRACT

The objective of this study was to formulate and characterize an eggplant-based edible sheet with whole eggplant (Solanum melongena) puree as a substitute for nori sheets as a type of sheet food product. In particular, it was intended to determine the formulation, processing procedure, sensory attributes, consumer acceptability, and microbiological quality. A quantitative experimental research design was used to formulate the Eggplant Sheet using whole eggplant puree, carrageenan, modified starch, and other ingredients by means of roasting, blending, mixing, spreading, and oven drying processes. Sensory analysis was carried out based on their color, aroma, texture, and overall acceptability using a nine-point hedonic scale. The results revealed that the Eggplant Sheet attained a sensory grand mean of 8.14 compared to the 7.90 mean of the Traditional Nori Sheet. The Eggplant Sheet had weighted means of 7.96 for color, 7.94 for aroma, 8.20 for texture, and 8.46 for overall acceptability. A paired-samples t-test showed that there was a statistical difference between the two samples, with a computed t-value of 2.444, 49 degrees of freedom, and p-value of 0.018 at 0.05 level of significance. In addition, the microbiological analysis showed Escherichia coli value and was recorded to be less than 2.2 MPN, which is lower than the reference limit of less than 10 MPN. This study suggests that whole eggplant puree can be used to formulate an acceptable sheet-type food product. Future researches may focus on its nutritional value, shelf life, microbiological safety, formulation, and others.

Keywords: Eggplant sheet, whole eggplant puree, product development, sensory evaluation, consumer acceptability, nori alternative, microbiological analysis.

INTRODUCTION

Eggplant (Solanum melongena L.) is a popular vegetable crop in many countries. And according to the Philippine Statistics Authority (PSA, 2023), eggplant is one of the main vegetable commodities grown in the Philippines. However, fresh eggplant has a limited shelf life and is susceptible to quality deterioration after harvest. Its nutritional and functional properties make it a promising material for the development of processed food products, while its perishability emphasizes the importance of proper preservation and utilization technologies. The process of transformation may allow creating new food products using local raw material resources. Eggplant can be turned into a sheet as one of the possible variants of the usage of eggplant in this regard. Despite the significance of eggplant both nutritionally and agriculturally, there is no experience in using eggplant for producing innovative sheet-form products. Eggplant products that exist are traditionally limited to food preparation or selected processed products. This could create a possible attempt at developing and characterizing eggplant sheets using whole eggplant puree as the raw material.

More specifically, the study aims at formulating and developing an appropriate process for making the sheet; determining the physical attributes of the sheet and analyzing its sensory acceptability regarding appearance, aroma, texture, taste, and overall acceptability. The comparison of the developed eggplant sheet to a regular nori sheet is strategically conducted and evaluated. In summary, this study evaluates the potential of eggplant as a locally available ingredient for the production of a processed food product. Unlike other studies that emphasize the medicinal benefits of eggplant, this study concentrates on utilization, formulation,

characteristics, and acceptance of the product. By formulating a sheet from whole eggplant pulp, the study endeavors to establish that eggplant can be made into an acceptable sheet product.

Objective of the Study

The study aims to make an Eggplant based Nori sheet food alternative to traditional Nori sheets and to evaluate its microbiological characteristics and sensory acceptability in terms of taste, texture, aroma, appearance, and general acceptability shows how well consumers like the product and how it's economic feasibility.

MATERIALS AND METHODS

Research Design

This study uses a quantitative experimental approach. Whole fresh eggplant was subjected to processes of cleaning, slicing, roasting, blending, and drying so that the sheet will be form and could be produced. The prepared eggplant sheet was tested in sensory evaluations and microbiological analysis.

Participants and Sampling

The study involved 53 participants, consisting of 50 consumer participants and 3 expert participants. The experts included professionals with expertise in food technology, including DOST specialists, scientists, and expert in Japan cuisine. Among the 50 consumer participants, 42 were female and 8 were male. The three expert participants consisted of 1 female aged 29 and 2 males aged 32 and 30. On the fifty consumer participants ages below 18 consist of 10 participants, and ages 19-30 consist of 40 participants) were participated. Purposive sampling was used for the sensory assessment. Participants were recruited from Bulacan State University–Sarmiento Campus and included consumers and professionals.

Participants Profile

Gender	Frequency		Percentage	
	Consumer	Experts	Consumer	Experts
Female	42	1	84%	33%
Male	8	2	16%	67%
Total =	50	3	100%	100%

Table 1: Gender profile of consumers and experts

Table 1 below shows the gender demographics of the consumers and experts involved in the research process. Of the 50 consumer respondents, 42 (84%) were female and 8 (16%) were male. Thus, the consumer group was predominantly female. On the other hand, out of the three expert respondents, one (33%) was female while two (67%) were male. In this case, it is evident that there was more representation of males than females in the expert category. In summary, the table above shows that there was equal representation of both genders in the research process but in different proportions. The consumer respondents were predominantly female respondents while the expert respondents were predominantly male respondents.

Age	**Frequency**	**Consumer (%)**
Below 18	10 respondents	20%

19 – 30	40 respondents	80%
31 – 45	0 respondents	0%
46 years old and above	0 respondents	0%
Total =	50 respondents	100%

Table 2. Consumer Age Group Profile

Meanwhile, the table above shows that the majority of respondents were 19–30 years old, comprising 40 respondents (80%). This indicates that most participants were young adults, consistent with the university-based setting. Followed by 10 respondents or 20% who are below 18 years old. Overall, the result concluded that the majority of the respondents or participants of the survey are young adult group students given that the study was conducted at the university, which reflects on their preferences and responses in the conducted study.

Product Development

The process begins with eggplant selection, washed, and cut into halves to help them roast and blend quickly. Once roasted, the eggplant is blended into a fine puree, retaining its pulp, skin, and fiber rather than straining it into a water extract. These inputs undergo research development and are processed through Combined Modified Starch Gel Pro and Carrageenan. This method is used to transform eggplant materials into structured sheets through mixing, heating, and drying. Three trials were conducted, with the final trial involving modifications to the preparation, roasting, blending, and drying procedures to improve the product's color, taste, and aroma. The resulting product is eggplant sheet, which is then subject to sensory evaluation by expert, student, and panelists using criteria such as flavor, aroma, appearance, texture, and overall acceptability. The production process used 500 g of whole eggplant as the raw material, with clean water used for washing. Ingredient preparation took approximately 10 minutes, roasting took 35-45 minutes in 200°C, and blending for 5-6 minutes including the incorporation of other ingredients and until a smooth and uniform puree is obtained, and drying took 4-6 hours at 75°C, lastly packaging took approximately 35 minutes. The final eggplant-edible sheet was packed in quantities of 100 g per package. The packaged product was stored at room temperature in a sealed package and kept in a clean cabinet.

Table 3: Summary of the Six Product Development Trials

Trial	**Processing Approach or Modification**	**Observation or Result**	**Decision for the Next Trial**
Trial 1	Drying in a high temperature and longer time.	The product was burned, uneven, rough, and fragile.	Oven drying in appropriate temperature and time control.
Trial 2	Small amount of gelling agent. And cooking before drying.	The product didn't form as sheet.	Additional gelling agent and directly drying instead of cooking first.
Trial 3	Final modifications were made to the preparation, blending, and drying. Such as 500g eggplant puree was used, 7g of modified starch gel pro, 3g of carrageenan, 10ml of soy sauce, 5ml of rice vinegar, 2g of salt, 3g of spiriluna powder, and 2.5ml of olive oil.	The final trial was reported to have the desired color, taste, aroma, and appearance.	The final product was selected for sensory evaluation.

Research Instrument and Sensory Evaluation

The questionnaire designed by the researchers based on a nine-point Likert scale was employed in the collection of evaluation on the developed Eggplant edible sheets. In the sensory evaluation test, there were 53 participants, which include 3 experts. The participants evaluated the eggplant sheet through the analysis of aroma, color, texture, taste, and overall acceptability. The data obtained was analyzed using the weighted mean in order to determine the level of acceptability of each attribute in the sensory evaluation. Frequency and percentage were also employed to provide summary of demographic data of the respondents. The weighted mean scores were interpreted using the nine-point acceptability scale, ranging from Dislike Extremely to Like Extremely.

RESULTS

Product Development Result

Three trials were conducted to develop the eggplant-based edible sheets. During the early trials, the researchers encountered difficulties in controlling the roasting process and achieving the desired product characteristics. In the subsequent trials, adjustments were made, gelling agent were modified and drying method are monitored throughout the trials to improve the product's color, flavor, aroma, and roasted bitterness. Based on the researchers' observations, the final trial achieved the desired color, flavor, aroma, and roasted taste. Moreover, in terms of physical attributes the researcher achieved the right thickness of the sheets of 1-1.5mm since it is not breakable. However, the researcher didn't focus on other physical attributes such as tensile strength, water vapor permeability, colorimetry, moisture content, and nutritional breakdown. And that could be a recommendation to the future researcher who will used this study for their reference.

Test	Actual Value	Stated Standard
Escherichia Coli	<2.2 MPN	Less than 10 MPN

Table 4: Microbiological Results

The microbiology analysis of the eggplant-based edible sheet showed total E. coli count of less than 10 MPN which proving that the sample is within the required microbiological standard of E. coli. The total E. coli count results were included in the report of the lab dated August 13, 2026. Though the research results indicate that the results comply with the relevant standard values, it is vital to specify which standards, categories and acceptable limits we are mentioning.

Sensory Attribute	Weighted Mean	Interpretation
Aroma	7.94	Like Very Much
Color	7.96	Like Very Much
Texture	8.20	Like Very Much
Overall Acceptability	8.46	Like Extremely
Grand Mean	**8.14**	Like Extremely

Table 5: Sensory Evaluation Results

Sensory attributes of the eggplant-based edible sheet were assessed using the nine-point acceptability rating scale. The findings obtained show that the texture attribute got the highest weighted mean of 8.20, whereas

the lowest weighted mean was 7.94 for the aroma attribute. Thus, a grand mean of 8.14 demonstrates that the eggplant-based edible sheet was found acceptable by the respondents.

As far as various sensory attributes were evaluated, the texture attribute scored the highest while aroma scored the lowest. This means that the respondents preferred the texture of the eggplant-based edible sheet over its aroma. It is important to mention that the low score of the aroma attribute shows that this attribute can be enhanced in further formulation process as well as roasting trials.

Sample	**Grand Mean**	**Degrees of Freedom**	**P-Value**	**T-Critical**	**Level of Significance**	**Decision**
Sample A (traditional Nori Sheet)	**7.90**	**49**	**0.018**	**2.009**	**0.05**	**Significant**
Sample B (Eggplant Sheet)	**8.14**					

Table 6: Statistical Analysis Result

Table 6 presents the paired-samples t-test results for the sensory evaluations of Sample A and Sample B. Sample A had a grand mean of 7.90, whereas Sample B had a higher grand mean of 8.14. The test yielded $t = 2.444$, $df = 49$, and $p = 0.018$.

At the 0.05 significance level, $p = 0.018$ is less than 0.05; therefore, the difference between the sensory evaluations of Sample A and Sample B is statistically significant. Therefore, the null hypothesis is rejected, indicating a statistically significant difference between the respondents' sensory ratings for the Traditional Nori Sheet and the Eggplant Sheet, $t(49) = 2.444$, $p = 0.018$.

CONCLUSION

This experiment proved to be successful in the creation of sheets made out of eggplant. The scores that were obtained as a result of perceptual evaluation have shown the overall average score of 8.14, which is an acceptable score. Texture scored the highest and aroma scored the lowest of all sensory attributes, which means that there is still a lot to do in this field. The microbiological evaluation shows analysis of less total coliforms.

RECOMMENDATIONS

1. Eggplant-based edible sheet can be explored in terms of food applications like kimbap, siomai, and lumpia, depending on the flexibility, toughness, and filling capacity of the product.

2. Optimize drying, roasting, and blending process controls so that flavors, colors and textures of the product would be at their best.

3. Conduct research on formulation and production improvement enhancing its quality.

4. Investigate nutrition value of the product, and its other physical attributes.

5. Conduct studies using a larger and varied number of respondents in order to get a broader understanding of the preferences of consumers.

Ethics Statement

Participation in the sensory evaluation was voluntary. The researcher had provided a brief explanation about the details and purpose of the study to the participants and respondents. All information is kept and treated

with the highest confidentiality not disclosing the names and identities of research respondents and participants, in order to assure anonymity and confidentiality and to avoid potential harm and was used solely for research purposes.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to applicable privacy and confidentiality requirements.

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