Development and Acceptability of Tempeh-Based Longanisa

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ABSTRACT

The increasing demand for healthier food alternatives and food products has led to developed plant-based alternative to traditional meat products. This study focuses on developing Tempeh as a natural alternative to traditional meat longanisa. Tempeh, a fermented soybean product is rich in protein, nutritional value and containing certain health benefits which makes it a suitable alternative for processed meat longanisa.

The study aimed to develop and formulate Tempeh-Based Longanisa that will resemble the sensory characteristics of traditional meat Longanisa. A sensory evaluation comparison between tempeh and traditional longanisa are determined among 50 random respondents to assess consumer acceptance and identify the areas for improvement. The product also undergoes Microbiological and Sensory Analyzation under Department of Science and Technology (DOST) in Malolos, Bulacan. Three Experts are also used as Validators for Tempeh Longanisa to gather valuable expertise and recommendations for improvement.

To measure the comparison between the two, the study used a Paired T-Test Formula to compared the data of the Sample A (Tempeh Longanisa) and Sample B (Traditional Longanisa). The Findings revealed that the 50 respondents who participated in the study generated a reported grand mean of 4.49, while the traditional sample received 4.46 and received a positive correlation between the two which means the Tempeh Longanisa can be utilized as a substitute meat for Traditional Meat Longanisa. The microbiological analysis also obtained an acceptable result in all parameters of the FDA. DOST sensory testing also describes the product as Slightly Like although the aftertaste is identified as an area for improvement. These findings indicate that the Tempeh Longanisa has a promising sensory acceptability measure but the study is limited in conducting Long Term Shelf Life, Nutritional Analysis and Commercial Feasibility. Also, the product contains Egg Whites as a binder which the product should not be regarded as fully vegan.

Keywords: Tempeh, Longanisa, Plant-Based Alternative, Sensory Evaluation, Product Development, Microbiological Analysis

INTRODUCTION

Longanisa, a type of sausage that is popular in The Philippines are valued for its flavor and its impact especially in everyday meals and food traditions. These products are made in process meats which an interest in plant-based food has encourage for developing an alternative and imitate the sensory qualities of these conventional products. According to Prakash et al. (2023), plant-based foods are one of the approaches to a more sustainable food system. Also, soybean-based products have the potential to be utilized as a meat alternative (Forooghi et al., 2024).

Tempeh, a fermented soybean that originated from Java Indonesia has the potential as a meat analog. Additionally, its fermentation process influences the nutritional and sensory characteristics of the soybeans, (do Prado et al., 2022; Elhalis et al., 2023). Prior to research studies, tempeh has been developed and examined in meat products, including sausages formulations which suggests that it can be a useful ingredient in formulating Longanisa Sausages. However, tempeh based longanisa should be assessed for its taste, texture, aroma, appearance and, acceptability and microbiological quality.

The study aimed at developing Tempeh-Based Longanisa as an alternative for traditional process-meat longanisa and be compared for its sensory qualities. The study also conducted expert validation, laboratory results including Microbiological and Sensory Analysis. Product Trial-and-Error. It also focused only on developing tempeh-based longanisa which the study limits on nutritional profile, long term shelf life and commercial feasibility.

METHODS

Research Design and Setting

The study used a quantitative experimental approach with numerous trial-and-error methods for product development. The study conducted at the Bulacan State University-Sarmiento Campus located at City of San Jose Del Monte, Bulacan, Philippines. Also, consumer evaluation involves 50 voluntary respondents and 3 Expert Validators which assessed the product.

Tempeh Preparation and Product Development

Soybeans are prepared and soaked overnight, and boiled for approximately 30-45 minutes to hulled the peels. They are drained and cooled for moisture reduction. The soybeans are mixed with tempeh starter and vinegar and incubated at 30 °C. Fermentation Process continued for 2-3 days and then are refrigerated after they are fermented.

For the formulation, final trial method used a 500g Tempeh, 50g Egg White, 50g cornstarch, 40g all-purpose flour, 20g cold water, 100g brown sugar, 1 piece of garlic, 25g soy sauce, 10g vinegar, 5g salt, pepper and msg, 10g curing salt and paprika. The development is adjusted throughout six trials. Numerous methods for trial-and-error include reducing additives, adjusting formulation, egg white addition for binder, starch adjustment, temperature control and, casing handling.

Sensory Evaluation

Fifty respondents evaluated the samples and coded as Sample A, tempeh-based longanisa, and Sample B, traditional longanisa. The evaluation used a five likert scale to assess taste, texture, aroma, appearance and acceptability. The study also ensure that the participation was strictly voluntary, samples remain anonymous and coded to reduce bias and soy allergic individuals were also excluded. Additionally, three expert validators were separately evaluated for the product.

Microbiological Testing

The study undergoes microbiological analysis at the DOST Analytical Testing Laboratory in Malolos, Bulacan. The conducted tests included aerobic plate count, Escherichia coli, Salmonella, Staphylococcus aureus, Listeria monocytogenes, and Enterobacteriaceae. A separate sensory analysis was also reported from the laboratory using a five-point hedonic scale.

Statistical Treatment

Weighted Mean were used for summarization of the results. A paired t-test are also used to conduct comparison of the samples, using a 0.05 significant level. The interpretation follows the statistical results stated in the research study.

RESULTS

Trial-and-Error Formulation

The research conducted six trials. Early trials were experiencing rupturing casings and formulation sensory problems. These problems were addressed including changing the casing, overfilling reduction, starch adjustment, prickling air bubbles. Later trials were improved and resembling longanisa due to addition of the

egg white for binding. Paprika was also added for improving the color. The study also documented that the tempeh-based longanisa were remained compact during cooking process and resembling the appearance of the traditional longanisa. However, the aftertaste of the fermented soybean was reduced but not eliminated after numerous trials which remains an area for improvement.

Microbiological Results

Type of Test	Actual Value	FDA Standard Value
Aerobic Plate Count	Less than 10 cfu/g	less than 10^5 cfu/g
Escherichia coli	9.2 MPN	less than 10 MPN
Salmonella	Not detected	absent/not detected
S. aureus	5.1 MPN	less than 10 MPN
L. Monocytogenes	Not detected	absent/not detected
Enterobacteriaceae	Less than 10 cfu/g	less than 100 cfu/g.

Table 1. Microbiological Analysis of Tempeh Longanisa

The table shown stated that the product met the standard of the Philippine FDA which means that the sample **PASSED** all the microbiological analysis. However, E.coli result was close to the limit and the laboratory testing center recommended for the sanitation process. These results, therefore, should be interpreted with caution considering the laboratory report, the type of food involved, the conditions of sample collection, units used, and the regulatory guidelines. However, passing the above tests is not a guarantee that the product is safe at all times.

Sensory Analysis Result

	Average Score	Reference Method	Interpretation
Appearance (Toasted)	**4.3**	5-point Hedonic Scale	Like Very Much
Aroma (Meaty)	**4.1**	5-point Hedonic Scale	Like Slightly
Flavor (Savory)	**3.6**	5-point Hedonic Scale	Like Slightly
Texture (Firmness)	**3.9**	5-point Hedonic Scale	Like Slightly
Mouthfeel (Chewability)	**3.7**	5-point Hedonic Scale	Like Slightly
Aftertaste	**3.3**	5-point Hedonic Scale	Neither Like nor Dislike
Acceptability	**3.7**	5-point Hedonic Scale	Like Slightly

Table 2. Sensory Analysis of Tempeh Longanisa

The table shown is the sensory analysis of the product, which are conducted also in DOST Analytical Testing Center in Malolos, Bulacan. Based on the 5-point hedonic scale that are conducted by the DOST, the results show that the product achieved an interpretation of Like-Slightly based on the 5-point Hedonic Rating Scale. The lowest score achieved is in the aftertaste category, which means that the product should be improved

regarding its aftertaste. Additionally, the Appearance achieved the highest result which means that the product met the expectation of the evaluators that evaluate the product. Overall, the product showed that it is capable of imitating the sensory attributes of a traditional Meat Longanisa, given that it is made from fermented soybeans.

Expert Validation Result

Sensory	Validator 1	Interpretation	Validator 2	Interpretation	Validator 3	Interpretation
Taste	4.60	Extremely Like	4.80	Extremely Like	4.40	Extremely Like
Texture	4,80	Extremely Like	5	Extremely Like	5	Extremely Like
Aroma	4.60	Extremely Like	5	Extremely Like	4.40	Extremely Like
Appearance	4.60	Extremely Like	5	Extremely Like	5	Extremely Like
Acceptability	4.80	Extremely Like	5	Extremely Like	4.60	Extremely Like
Total	**4.68**	Extremely Like	**4.96**	Extremely Like	**4.68**	Extremely Like
GRAND MEAN		**4.77**		**Extremely Like**		

Table 4. Expert Validation Result of Tempeh Longanisa

Based on the data shown in the table, the sensory evaluation obtained from the three validators achieved a grand mean of 4.77 and interpreted as Extremely Like. All of the validators obtained an interpretation of Extremely Like indicating that the product was highly acceptable to the validators in terms of Taste, Texture, Aroma, Appearance and Acceptability.

Consumer Evaluation Result

Sensory Attribute	Weighted Mean			
	Sample A (Tempeh Longanisa)	Interpretation	Sample B (Traditional Longanisa)	Interpretation
Taste	4.43	Extremely Liked	4.44	Extremely Liked
Texture	4.46	Extremely Liked	4.52	Extremely Liked
Aroma	4.59	Extremely Liked	4.47	Extremely Liked
Appearance	4.46	Extremely Liked	4.38	Extremely Liked
Acceptability	4.52	Extremely Liked	4.50	Extremely Liked
Grand Mean	4.49	Extremely Liked	4.46	Extremely Liked

Table 5. Result of Consumer Evaluation of Tempeh and Traditional Longanisa

Based on the table shown above, the results showed that the sensory attributes of Sample A and Sample B were highly similar across all sensory attributes. The data for Sample A obtained a grand mean of 4.49, while Sample B obtained 4.46, indicating small difference of 0.03 between the two samples. Also, the scores of the Taste, Texture, Aroma, Appearance, and Acceptability were highly comparable, with the samples generating an interpretation of “Extremely Liked”. This similarity suggests that the Tempeh Longanisa was able to achieve

sensory comparison to traditional longanisa and was generally accepted by the 50 respondents who participated in the study.

Paired Samples Comparison

The study resulted a paired t-test result of p = 0.77 at 0.05 significance level. Since the P-Value is greater than the level of significance, **the alternative hypothesis is rejected** therefore, there is no significant difference between the data of Tempeh Longanisa and the Traditional Longanisa hence, the data interprets that the Tempeh and Traditional Longanisa have comparable acceptability levels based on the respondents who participated in the study.

CONCLUSION

The study suggests that tempeh can be utilized and developed as a longanisa by conducting numerous trial-and-error methods. Among the 50 respondents, tempeh-based longanisa obtained a grand mean of 4.49 and traditional longanisa obtained 4.46 and both interpreted as extremely liked. The study also obtained comparison which resulted in a no significant differences were detected at 0.05 level. Expert Validators also gave the product a grand mean of 4.77 while, sensory evaluation from DOST described it as Like Slightly and recommends that the aftertaste category should be improved. Microbiological Values were also passed all parameters of the FDA. Overall, the findings support that tempeh can be developed as longanisa but lacking claims regarding its nutritional values, shelf life and its commercial feasibility due to the limitation of the study.

RECOMMENDATIONS

- Refine the formulation to reduce the fermented-soy aftertaste and improve flavor, texture, and appearance.
- Verify and standardize the final recipe and clearly label all ingredients, including curing salt and binders. If a fully plant-based product is intended, replace egg white with a suitable plant-derived binder and evaluate the revised formula.
- Repeat microbiological testing using the appropriate food category and current regulatory criteria; strengthen sanitation and prevent cross-contamination, particularly during fermentation, processing, and packaging.
- Conduct a shelf-life study under defined refrigerated and frozen storage conditions, using appropriate microbiological and quality indicators.
- Perform nutritional analysis before making claims about protein, sodium, fat, or other nutritional advantages.
- Recruit a larger, more diverse respondent group and report complete descriptive statistics and paired-test details, including the test statistic, confidence interval, and respondent-level analysis where available.
- Evaluate production costs, packaging, storage, distribution, and consumer willingness to purchase before considering commercialization.

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