Development and Acceptability of Solanum Melongena L. and Tofu TVP as an Alternative Meat for Vegan Hotdog

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ABSTRACT

This research investigates the development of eggplant (Solanum Melongena L.) and Tofu TVP-based alternative meat and its acceptance by consumer. It's designed to offer a healthier and more sustainable choice for those who consume animal products like chicken, pork and beef regularly. With the growing awareness of the damage inflicted by meat production, many people are looking for alternatives. The health risks from processed meats have also played a role in the growing popularity of plant-based alternatives.

Though plentiful, eggplant and Tofu, with its meat-like texture and health benefits, is still underutilized in the Philippines. This research is aimed at developing an adaptable eggplant-tofu product for consumers of beef, hog and poultry products. Ethical, health and environmental concerns related to conventional meat production are contributing to the rise in popularity of plant-based options. Eggplant and tofu, due to its fibrous characteristics and nutritional value, are regarded as the sustainable and promising materials for the production of meat equivalents.

Processing methods that improve its meat-like properties and convenience for consumers and its market potential are also discussed. The overall objective of the research is to decrease the amount of meat consumed, decrease food waste, and assist in the economic development of rural communities by creating value added eggplant and tofu products.

Keywords: Eggplant; tofu based T.V.P. (textured vegetable protein); plant-based food; vegan hotdog; sensory acceptability

INTRODUCTION AND LITERATURE REVIEW

As people seek out food options that align with their health, animal care and environmental concerns, along with lifestyle choices and dietary preferences, plant-based meat alternatives have become a growing focus. The products are intended to be similar in some or all desirable meat qualities, including shape, texture, flavor and appearance. But, not only is it necessary to substitute the animal ingredients with plant materials, but also to create a meat alternative that is acceptable. Ingredient functionality, processing conditions, moisture control, binding, seasoning, and consumer exp ectations all influence the quality of the finished product. In the recently published systematic review on Textured Vegetable Protein in Meat Analogues, Baksh et al. (2022) highlighted the significance of texture, physicochemical properties and sensory attributes as areas of assessment for this type of product.

The use of TVP in meat analogues is based on the fact it can be used to give a fibrous or structured protein component. The performance of it is dependent on protein source, processing history, hydration, particle size and interaction with other ingredients. In sausage-type products, the protein ingredient should be evenly distributed and the mixture should do the following: 1) be shaped easily and 2) maintain its shape after cooking. Excessive moisture can cause softness or weakness, and too little moisture or the wrong binder can cause dryness and crumbleness, or a grainy mouthfeel. The review by Bakhsh et al. (2022) discusses the application of TVP in meat analogues and highlights the impact formulation can have on product quality

with the inclusion of binding agents. The impact of the type of TVP on the quality of plant-based meat products was also studied by Tunnarut et al. (2022), reinforcing the need to carefully choose and prepare the protein ingredient for the product.

This work aimed to use eggplant (Solanum melongena L.) as an ingredient to use along with TVP made from tofu to make a hotdog-like plant-based product. Eggplant is a vegetable that can be used in many food preparations, and may be an excellent source of moisture and a soft vegetable base that absorbs seasonings

easily. These are all attributes that will be helpful in product development, but the amount of moisture also poses a formulation problem for the vegetable. Unless eggplant is drained and prepared regularly, there is a risk of the mix getting too soft and not retaining form. Thus, the ratio of vegetable to protein ingredient to binder, the particle size and the single method of eggplant preparation are key factors to be standardized. Nutritional superiority claims must not be made based on the choice of ingredients only, but would have to be substantiated through direct nutritional analysis.

A sensory evaluation is crucial in the development of foods that will be substitutes of familiar foods. A product is accepted by the consumer if it looks, smells, tastes and feels good. Kumari et al. (2023) also summarized sensory evaluation of plant-based meat and summarized the ongoing gap in sensory perception between plant-based and animal-based meat products. Jang and Lee (2024) also explored progress in plant-based meat alternatives, such as enhancing sensory and nutritional qualities. With a vegan hotdog, all of these attributes are particularly important when assessing the product, as the consumer may be looking for a familiar shape, savory aroma, even flavors, and a well-integrated texture. Technically, a product could be malleable but still need refinement because it tastes earthy, has uneven texture or looks different than what was expected by consumers.

The local nutritional evidence also highlights the need to consider plant-based products on a case by case basis and not assume the same nutritional profile. Pagulayan et al. (2024) evaluated the nutritional characteristics of the plant-based meat alternatives found in the market in the Philippines. They also studied a number of different product types such as patties and sausages and the authors reported that there were differences in nutrient levels between product types and ingredients in their samples. There were also general differences between plant-based and animal-based options for energy, fat, dietary fibre, sodium, calcium and price per gram of protein. The results indicate that the nutritional characteristics of a new product must be determined directly prior to considering health related claims.Product development therefore involves balancing ingredient functionality with sensory quality and reproducible processing. The eggplant component may contribute moisture and flavor absorption, while tofu-based TVP may contribute protein and structure. Their combination requires controlled preparation and appropriate binding and seasoning. Repeated formulation trials can help identify practical issues such as excessive softness, graininess, casing failure, shrinkage, or unbalanced flavor. Nevertheless, observations from trials should be reported as product-development findings rather than proof of nutritional benefit or commercial readiness.

The present study is aimed at developing and acceptance of eggplant and tofu-based TVP vegan hotdog. It assesses the appearance, aroma, taste, texture and overall acceptability from a group of selected students and food-processing experts. The work also provides selected microbiological test results (confirmation of official laboratory report and applicable standards). It does not provide for long term storage or full nutritional profile or commercial manufacturing. These limitations are significant since sensory acceptance and selected microbiological results are used to answer different questions and are not a substitute for nutritional analysis, shelf-life testing or a complete food-safety assessment.

The goal of the study is to generate preliminary data to determine if the ingredients selected can be incorporated into a product resembling a hotdog that can be accepted by the respondents. The study should provide information to guide future formulation that can be documented in terms of observations of product development and sensory responses. It also serves as a foundation for future testing for nutritional composition, texture, packaging performance, and storage stability. The contribution made by the study is therefore practical rather than necessarily claiming superiority for all plant-based products over conventional meat products and is exploratory in nature.

METHODOLOGY

The design of research and research environment. A quantitative product-development and sensory-evaluation approach was employed in the study. The product was formulated, followed by evaluation of the selected respondents in Bulacan State University–Sarmiento Campus, San Jose del Monte City, Bulacan. Sixty student consumers and 3 food-processing experts are listed on the manuscript. Simple random sampling was used in selecting the student respondents and the experts participated voluntarily. There was no compulsory participation and food allergies were screened prior to tasting. Lastly, the final manuscript should mention the approved consent procedure and any institutional requirements that were observed.

Product development. Eggplant was cleaned and processed to be used in the product. The tofu-based TVP ingredient was prepared and mixed with other elements of the recipe, seasonings and binders. The mixture was formed into hotdog-like links, cooked, cooled and packaged as described in the working procedure. A number of tests were carried out to overcome the above mentioned issues of softness, graininess, bitterness, earthiness, failure of casing, shrinkage and varying texture. The product was improved by adjusting the ingredient preparation, moisture management, seasoning, binder distribution, and cooking. The researchers need to enter the exact amounts of the last ingredients, preparation times, cooking temperatures, cooking time, type of casing, and storage conditions from their laboratory record to be reproducible. These values must be measured or calculated from scratch.

Sensory evaluation. The questionnaire for the assessment of appearance, aroma, taste, texture and overall acceptability was developed by a researcher. The five-point scale Not Acceptable – Highly Acceptable was used to record responses. Each of the numerical points must be verbally interpreted and must be reproduced in the final manuscript as it was interpreted. It was decided to have separate summaries of the student consumers and food processing experts due to their differential size and function. If applicable, the count of participants who finished each assessment and of any responses that were not completed should be reported.

Data analysis. Data on respondent characteristics were summarized using frequencies and percentages. Product-development and sensory ratings were summarized by means. The means reported in this draft come from the study materials themselves, and are to be recalculated with the original response sheets prior to submission. If there are significant differences found between age, gender, or dietary-preference groups, the following statistical test, its underlying assumptions, the significance level, the test statistic, degrees of freedom, and the p value should be provided from the actual analysis. Inferential results must be computed from the original data in order to be added.

Microbiological analysis. The product was tested for the following microbiological tests: Escherichia coli, Salmonella, Listeria monocytogenes, Enterobacteriaceae, Staphylococcus aureus, yeasts and molds, and aerobic plate count. The final manuscript should reference the official lab report, method, units, detection limit (if applicable), sample condition and applicable product standard. If the result is reported as "not detected" or "below" a limit, the language and units (e.g., "not detected" or "below 100 ppm") must remain the same as the original laboratory report. The microbiological results of this study should not be used as evidence of shelf stability or overall safety without verification of the standards and testing conditions.

RESULTS AND DISCUSSION

Product development observations. Moisture management, binder distribution, seasoning balance, casing performance, and cooking conditions were found to impact the quality of the eggplant–tofu TVP hotdog in the formulation trials. Initial trials exhibited excessive softness or gummy consistency, bitterness or earthiness, casing failure, shrinkage, dryness and graininess. Later adjustments reported to have improved structure and flavor. The observations corroborate those of Bakhsh et al. (2022) that protein ingredients, binders and processing conditions are crucial in the development of meat analogues based on TVP.

The moisture from the eggplant and its ability to absorb seasoning may have been partially responsible for the soft cooked texture, which needed careful attention. If water is not managed consistently, it can weaken a

shaped product if it is excessive. Protein ingredients and binders can assist in keeping the mixture together but the optimal combination of the ingredients and processing is dependent upon the ingredients. Trial observations indicate that the ratios and preparation methods of ingredients can influence firmness and eating quality. Final quantities and processing conditions however must be verified on the laboratory record. Thus, these observations should not be interpreted as a complete recipe for processing, but rather as a description of the observations.

Respondent profile. The study materials report 60 student consumers: 34 males (56.67%) and 26 females (43.33%). By age, 34 respondents (56.67%) were 25–34 years old, 16 (26.67%) were 18–24, seven (11.67%) were 35–44, and three (5.00%) were 45 years old and above. In terms of diet, 45 percent of the respondents (75.00%) said they were flexitarian, 11 percent (18.33%) omnivores, two percent (3.33%) vegan and two percent (3.33%) vegetarian. An expert group comprised of three food-processing experts (2 males and 1 female). Two of the experts were aged between 25 and 34 years and one was aged 45 years or older. 3 out of 3 people identified as flexitarians. These are participant numbers only and not representative of all consumers.

Product-development ratings. The mean ratings of consumers for preparation procedure, formulation, texture and packaging were 3.99, 3.94, 4.49 and 4.46, respectively. The corresponding expert ratings were 4.82, 4.85, 5.00, and 5.00. Texture and packaging were rated higher by consumers than preparation procedure, and formulation. Formulation received the lowest consumer rating, possibly indicating a need for further recipe development or that the consumers saw potential for enhancing the recipe. High ratings were given by the experts in all four areas and the highest scores in texture and packaging. But caution has to be used in interpreting their ratings, as only three experts were involved. All means and grand means should be recomputed from the raw questionnaire answers prior to publication.

Sensory acceptability. The grand mean for the sensory characteristics of the student consumers was 4.68 and 4.86 for the experts. Overall acceptability scored 4.79; taste 4.76; texture 4.74; appearance 4.62; aroma 4.50 on a 1-5 scale. Experts rated overall acceptability at 4.96, texture at 4.95, taste at 4.85, aroma at 4.83 and appearance at 4.73. A positive response by the participants can be assumed, if the scale coding and verbal interpretations are correct. Overall acceptability was the best rated in both groups. Aroma had the lowest rating amongst both consumer and expert attributes, and appearance had the lowest rating amongst the expert attributes. The results can be used for identifying areas for improvement, but no statistical statement of significance should be made if the differences between the attributes have not undergone an appropriate test.

The sensory results are linked to the work of previous plant based meat analogues studies. Kumari et al. (2023) argue sensory properties are an ongoing challenge in product development to create products that mimic the experience of animal meat. Sensory and nutritional characteristics are other areas that Jang and Lee (2024) note warrant improvement. The present result indicated that the product was generally accepted and the lower score of aroma and appearance could be useful to guide the future formulation work. Further experiments might include the various quantities of seasonings, different ways of preparing vegetables, ingredient ratios, and different ways of shaping or casing. Variation of a single and/or small number of factors would enable the effects of those factors to be understood.

The study materials describe the product as being beany or nutty, earthy and lightly spiced, with a savory, mild sweetness and earthy taste. It was a pale tan-yellow with pepper and darker vegetable flecks. The texture was described as soft, dense, moist and tender, and it had a slight graininess and was quite firm with a smooth surface. The product was molded in the form of cylindrical links. These are observations of a qualitative nature unless they are gathered by a specified descriptive sensory technique. There is some graininess and earthiness that would need to be refined, but the positive taste and texture ratings indicate that respondents enjoyed some aspects of the product.

The findings should also be seen in the context of local information regarding alternatives to plant-based products. Pagulayan et al., 2024 reported that plant-based meat alternatives were available in the market in the Philippines, which had different nutrient profile based on product category and ingredients. This helps to

assess new formulations on a case-by-case basis. The present study did not include a comprehensive nutritional evaluation, so the product cannot be claimed to be higher in protein or lower in saturated fat or nutritionally superior to a standard hotdog based solely on the plant raw materials used. It was also not done on environmental assessment either, and so it is not possible to quantify or present environmental benefits as a measured gain.

Microbiological findings. The analysis of the supplied summary resulted in E. coli < 2.2 MPN; Salmonella not detected; Listeria monocytogenes negative; Enterobacteriaceae < 10 CFU/g; Staphylococcus aureus < 10 MPN; and yeasts and molds < 10 CFU/g. The aerobic plate count was reported as 100; the unit and appropriate acceptance criterion must be confirmed in the official laboratory report. That these values need to be compared

to the signed laboratory result prior to publication. The method, the way in which the sample is to be handled, the units, the detection limit and the standards to be used for this food group should be indicated. These result should be reported as laboratory results and not as final proof of safety or shelf stability of the product until these details are confirmed.

The mean reported sensory scores indicated that the eggplant–tofu TVP hotdog was well received by the respondents in the study. The results also highlight opportunities to enhance aroma, appearance and consistency in texture. More comprehensive conclusions need to be supported by a confirmation of the raw sensory data, final formulation, and laboratory report. Replicated production batches and a clearly documented comparison product (for comparative claims) should be tested in the future, as well as appropriate statistical analyses for the research questions.

CONCLUSION

The study developed a hotdog-style plant-based product using eggplant (Solanum melongena L.) and tofu-based textured vegetable protein (TVP) and assessed its acceptability among selected student consumers and food-processing experts. Based on the reported results, the product received generally favorable sensory ratings from both groups. The consumer group's reported sensory grand mean was 4.68, while the expert group's was 4.86. Overall acceptability was the highest reported attribute for both groups, at 4.79 among consumers and 4.96 among experts. These findings indicate that the product showed promise as a plant-based alternative within the specific respondent groups and evaluation conditions used in the study.

The product-development observations also indicate that formulation and processing are important to the quality of an eggplant–tofu TVP hotdog. Early trials experienced problems such as excessive softness, gumminess, graininess, earthy or bitter notes, casing failure, shrinkage, and dryness. Adjustments to ingredient preparation, moisture management, binder distribution, seasoning, and cooking were reported to improve the product. This highlights the need to standardize the preparation of eggplant and the tofu-based TVP ingredient, as well as the amount of binder and the processing conditions. A final recipe with exact quantities and reproducible steps is necessary before other researchers or food processors can repeat the product development.

The sensory findings should be interpreted as preliminary evidence of acceptability, not proof that the product is equivalent to a conventional meat hotdog. Consumer ratings were comparatively lower for aroma than for several other attributes, and the descriptive observations noted slight graininess and earthy notes. These features may guide further refinement. In addition, the expert group included only three people, so its high ratings should be treated as descriptive feedback rather than a broadly representative assessment. All means and grand means must be checked against the original response sheets, and any claim of a significant difference must be supported by the correct statistical analysis.

The reported microbiological results provide information on selected laboratory tests, but the official report, units, methods, and applicable standards must be verified before making a food-safety conclusion. These tests do not establish long-term shelf life. Likewise, the study did not measure the product's complete nutritional composition, compare its protein content directly with animal meat, quantify environmental

impacts, or establish commercial feasibility. It would therefore be inappropriate to claim that the product is nutritionally superior, shelf-stable, or ready for commercialization based on the current evidence.

In conclusion, eggplant and tofu-based TVP can be explored as ingredients for a plant-based hotdog that received favorable initial sensory responses. The study offers a useful starting point for additional product-development work, especially to improve aroma, appearance, and texture consistency. Before publication, the researchers should confirm the final formulation, verify the raw sensory data, check the official microbiological report, and complete the reference list with accurate, traceable scholarly sources. Further research should assess nutritional composition, storage stability, repeated-batch consistency, packaging performance, and consumer response using a larger and more diverse sample. These steps would provide stronger evidence about the product's quality, safety, and practical potential.

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