Formulation, Processing and Evaluation of A Soy-Free Coconut-Based Textured Vegetable Protein (TVP) Alternative

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DOI: https://doi.org/10.47772/IJRISS.2026.101100099

Received: 03 November 2026; Accepted: 09 November 2026; Published: 21 November 2026

BACKGROUND OF THE STUDY

The demand for plant based meat alternatives using protein based products that can replace or alter the widely used of regular meat protein are very fast growing demand in the market today because some consumer is health conscious or they want a cheaper option to replace meat product. And the product that can alter this regular meat is TVP or the Textured Vegetable Protein, and this is widely known as meat substitute or meat extender because of its meat like texture, somehow the problem is this meat substitute are made from the soy protein, that basically in food processing industry this is the one of the major food allergens that caused allergic reaction in some consumers when they consumed it Boukid et al. (2024).

That's why developing an alternative substitute for soy protein based TVP is one of the biggest challenge to solve this problem. But after a deep research somehow in some studies the coconut residue like coconut milk is one of the best option to alter the soy based TVP, in terms of same properties presents in soy and coconut milk, and aside from that, the coconut is locally available and abundant here in the Philippines. these study highlight the importance of developing a sustainable and locally available substitutes that can provide the similar texture and nutritional value without the limitations associated with soy based product that is locally sourced sustainable and suitable for consumers with soy allergies. (Santo et al., 2023).

Concept Explanation

Figure 1 presents the conceptual framework of the study which illustrates the process of developing and evaluating Coconut Textured Vegetable Protein (Coconut TVP) as a potential alternative to conventional soy-based TVP. The main material used for this study to alter the soy based protein as a meat substitute is coconut residue and that is coconut milk. the framework shows the three trials conducted an appropriate formulation and processing approach to determine if the coconut based TVP is acceptable to alter the soy based TVP as meat substitute and sustainable locally sourced protein alternative aligned with the findings of Santo et al. (2023) and Boukid et al. (2024).



Figure 1: Conceptual Framework

Statement of the problem

The demand for plant based meat alternatives using protein based products that can replace or alter the widely used of regular meat protein are very fast growing demand in the market today because some consumer is health conscious or they want a cheaper option to replace meat product. And the product that can alter this regular meat is TVP or the Textured Vegetable Protein, and this is widely known as meat substitute or meat extender because of its meat like texture, somehow the problem is this meat substitute are made from the soy protein, that basically in food processing industry this is the one of the major food allergens that caused allergic reaction in some consumers when they consumed.

1. Can coconut residue or coconut milk can be processed and can turn it into textured vegetable protein with meat like characteristics to alter soy protein as TVP?
2. What are the functional and nutritional properties of coconut based TVP compared to the traditional soy based TVP?
3. How can be acceptable the coconut based TVP in terms of sensory attributes such

3.2. Taste
3.3. Texture
3.4. Aroma
3.5. Appearance

4. Can coconut based TVP serve as a sustainable, cost effective and locally sourced alternative compared to soy based TVP?

Figure 2 the IPO diagram of the study shows how coconut residue or coconut milk are used as the main input in developing Textured Vegetable Protein (TVP). The process includes formulation, food processing, extrusion and sensory evaluation to achieve meat-like qualities similar to soy-based TVP. The expected output is a sustainable soy-free and locally sourced coconut based TVP that is acceptable in terms of taste, texture, aroma and appearance while also promoting the utilization of coconut by-products.

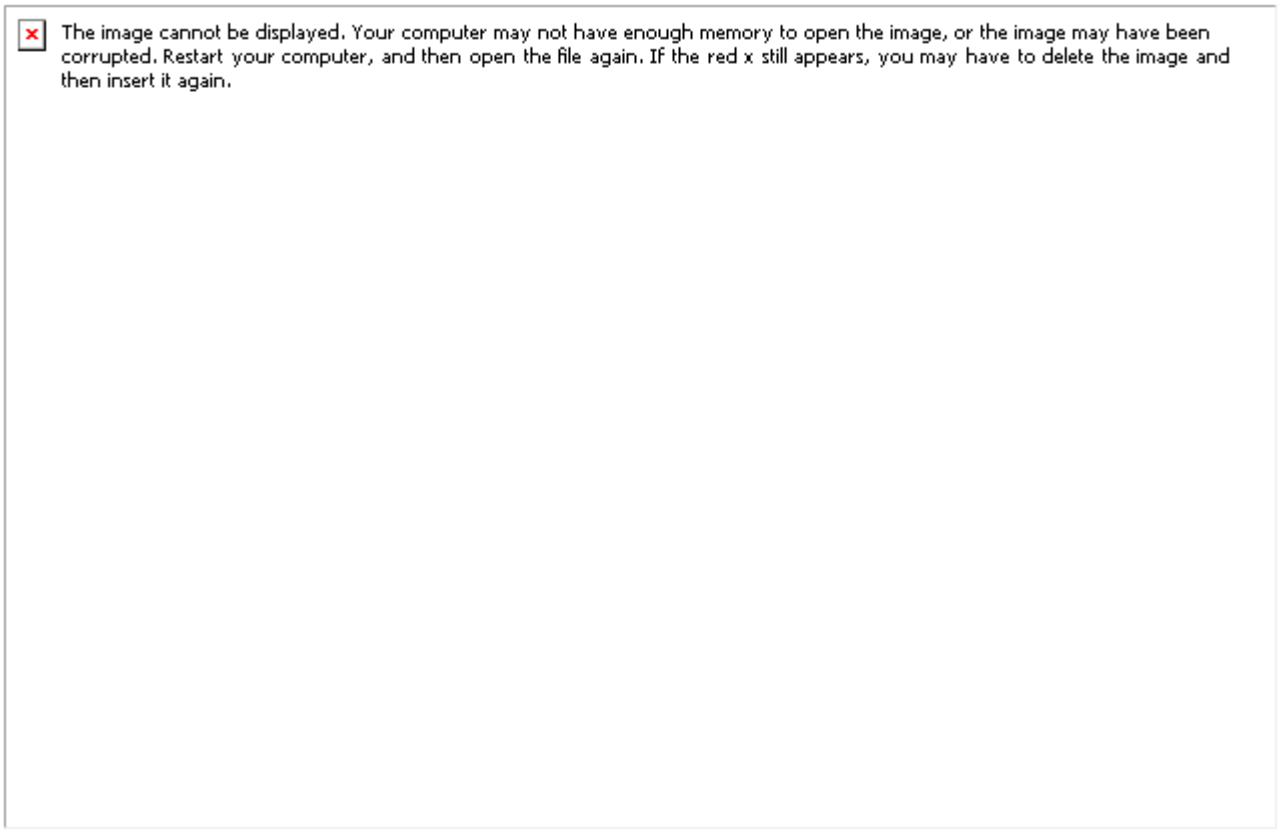


Figure 2: IPO Diagram For The Development of Coconut-Based Textured Vegetable Protein (TVP)

Objective of the Study

The main objective of study is to develop a new TVP using coconut based Textured Vegetable Protein (TVP) as a sustainable and locally sourced as alternative to a traditional soy based TVP and addressing concerns related to allergens and import dependence and limited raw material utilization in the Philippines.

Specific Objectives

To formulate a coconut based raw material blend suitable for TVP production using coconut byproducts such as coconut meat or coconut milk residue.

To process a coconut based ingredients and form into a textured vegetable protein using appropriate food processing techniques and methods.

To evaluate the physical and sensory properties of the developed coconut based TVP in terms of texture, appearance, taste and aroma.

To compare the acceptability and quality of coconut based TVP compared to a traditional soy based TVP.

To assess the potential of coconut based TVP as a sustainable and cost effective meat alternative.

Statement of Hypothesis

This study hypothesized that coconut based materials or by-products can be used as an alternative to soy protein in producing Textured Vegetable Protein (TVP) for meat substitute production. It assumes that coconut

based ingredients have the potential to replicate the texture and functional properties of soy based TVP. The null hypothesis states that coconut based materials cannot effectively serve as a substitute while the alternative hypothesis suggests that they can be a viable and effective replacement for soy protein in TVP production.

Experimental

Coconut based materials or byproducts can be used as an effective alternative to soy protein in producing Textured Vegetable Protein (TVP) as for meat substitute.

Method 1: Alkaline Texturization Method using Sodium Bicarbonate

The alkaline texturization method using sodium bicarbonate works by altering the protein structure of coconut based materials allowing them to develop improved elasticity and a more fibrous consistency.

Method 2: Acid-Induced Coagulation Method (Curd Formation Method)

The acid induced coagulation or curd formation method this method relies on the putting of an acid such as vinegar or citric acid to coconut based mixtures in order to coagulate proteins and fats and similar to the process used in making tofu or cheese.

Method 3: Mechanical + Starch Texturization

This method relies on the use of binding agents such as starch combined with manual or mechanical manipulation to create a fibrous structure that mimics meat. Instead of chemical modification the texture is developed through kneading stretching or shaping the mixture into strands

Scope and Limitation of the Study

This study focused on the development and evaluation of Textured Vegetable Protein (TVP) using coconut based materials or byproducts as an alternative to traditional soy protein. It aimed to determine the feasibility of coconut based ingredients in producing a meat substitute in terms of texture, acceptability and basic product quality. The study was limited to laboratory or small scale production and did not cover large scale industrial manufacturing. It also focused only on coconut based materials and does not compare a wide range of other

plant protein sources aside from soy protein as a reference. Furthermore, the evaluation is limited to basic sensory and product characteristics and does not include long term nutritional storage stability or commercial market performance analysis.

Significance of the Study

This study was significant because of it explored the potential of the coconut based materials or byproducts as an alternative raw material for producing Textured Vegetable Protein or also known as (TVP) which is commonly made from soy. The findings may benefit food researchers and developers by providing new insights into alternative plant based protein sources that are locally available and more sustainable. It can also help food manufacturers in developing more affordable and innovative meat substitute products for consumers especially those seeking plant based or soy free options this study may contribute to healthier and more diverse food choices.

1. **Food Researchers and Developers** – Provides new insights on using coconut based materials as an alternative to soy protein in TVP production to make a new source of protein that can be a meat substitute and replace or alter the soy based TVP that caused allergic reaction to some consumers.
2. **Food Manufacturers** – Offers a potential basis for developing a new affordable and innovative plant based meat substitute products.
3. **Consumers** – Gives more options for plant-based, soy free and possibly healthier food alternatives.
4. **Coconut Industry Producers** – Encourages utilization of coconut byproducts adding value to existing resources and additional revenue for local coconut producers.
5. **Sustainability Advocates** – Contributes to the development of more sustainable and locally sourced food ingredients

Operational definition of terms

1. **Acceptability** – The level of consumer approval or satisfaction regarding the quality and characteristics of the developed coconut-based TVP.
2. **By-products** – Secondary materials produced during coconut processing that are not the main product but can still be used for other applications such as food development.
3. **Coconut-Based Materials/By-products** – Raw materials derived from coconut processing, such as coconut meat residue, coconut milk residue, or coconut oil cake, used as potential protein sources in this study.
4. **Meat Substitute** – Food products designed to imitate the texture, taste or the appearance of meat but are made from plant-based ingredients.
5. **Sensory Evaluation** – The assessment of food products based on human senses such as taste, texture, aroma and appearance.
6. **Soy Protein** – A plant-based protein commonly extracted from soybeans and widely used as the standard ingredient in producing commercial TVP.
7. **Sustainability** – The ability to use coconut-based materials in a way that is environmentally friendly, locally available, and reduces dependence on imported raw materials.
8. **Textured Vegetable Protein (TVP)** – A plant-based food product made from protein sources that is processed to have a fibrous, meat-like texture and is used as a meat substitute.

REVIEW OF RELATED LITERATURE AND STUDIES

This section of the study focuses on the various literature relevant to the topic and the conduct of the study.

Foreign Literature and Studies

- **Textured vegetable proteins (TVP) as meat alternatives (** Future Foods 2023)

  The increasing demand for plant based meat alternatives has led to increased research on the Textured Vegetable Protein (TVP) as a key ingredient in meat substitute product. According to a study published in Science Direc TVP is widely used due to its ability to provide a fibrous meat like texture making it a

primary component in a plant based meat products It is commonly produced from soy wheat and pea proteins through extrusion processes which transform into plant proteins structured meat like forms.

- **Functional Properties of Texturized Vegetable Proteins: (Hong**, S., Shen, Y., & Li, Y. (2023).

  However recent studies highlight the need to explore alternative protein sources beyond soy. Research shows that different plant proteins can produce varying functional and sensory properties in TVP such as texture juiciness and rehydration capacity which directly affect the quality of meat substitutes. This supports the idea that non-soy materials can also be used to develop effective meat analogs.

- **Partial Soy Replacement and Moisture Optimization in Extruded Textured Vegetable Protein Ingredient (**ACS Food Sci. Technol. 2025, 5, 4, 1258–1267)

  Several foreign studies have also explored the use of non-traditional raw materials in TVP production. For instance, research on mushroom based TVP demonstrated that alternative plant sources can successfully be processed into textured protein using extrusion technology producing acceptable sensory and structural properties. Similarly studies on rice bran a by-product of rice processing show that it can be utilized as a protein source for partial replacement of soy in TVP highlighting the potential of agricultural byproducts in sustainable food development.

Local Literature and Studies

In coconut producing countries such as the Philippines there is a growing interest in utilizing coconut based byproducts as alternative food ingredients and the coconut residues such as coconut milk pulp and coconut oil contains residual proteins fiber and functional components that can be used in food product development. Local studies tell us that the coconut byproducts are often underutilized despite their nutritional potential. These materials can be processed into something value added products contributing to waste reduction and increased income for coconut farmers. The use of coconut based ingredients in food innovation aligns with sustainable practices and supports the country's agricultural resources. Although limited studies have directly focused on converting coconut protein into TVP related research shows that plant based byproducts can be modified through food processing techniques and methods such as extrusion to develop meat like textures given that other plant sources like mushrooms and rice bran have been successfully transformed into TVP coconut byproducts present a promising alternative for similar applications.

Synthesis of the Reviewed Literature

The reviewed studies indicate that while soy protein remains the dominant raw material for TVP production there is increasing global research on alternative plant based protein sources particularly agricultural byproducts. Foreign studies demonstrate that materials such as mushrooms and rice byproducts can be successfully processed into TVP with desirable functional properties. Meanwhile local literature highlights the abundance and potential of coconut byproducts as a sustainable and underutilized resource. However, there is still a research gap in the direct application of coconut based materials in TVP production. This study aims to address this gap by exploring the feasibility of using coconut by-products as a soy free alternative in producing textured vegetable protein for meat substitutes.

S.W.O.T

	Strengths (S)	**Weaknesses (W)**
Internal Factors	• Abundant and locally available coconut byproducts (Samarajeewa, 2024)	• Lower protein content compared to soy (Chen et al., 2024)
	• Contains functional proteins suitable for food applications (Chen et al., 2024)	• Weaker protein network formation affecting texture (Lallinger et al., 2025)
	• Promotes sustainability and waste	• Limited studies on pure coconut-based

	utilization (Lallinger et al., 2025)	TVP (Lallinger et al., 2025)
	• Soy-free alternative (Boukid et al., 2024)	• Processing challenges due to oil and fiber content (Lallinger et al., 2025)

Table 1: Swot Analysis Table

	Opportunities (O)	**Threats (T)**
External Factors	• Growing demand for plant-based meat alternatives (Boukid et al., 2024)	• Strong competition from soy-based TVP
	• Innovation in agricultural by-products (Nemli et al., 2025)	• Consumer acceptance challenges (taste, texture)
	• Supports local economy and reduces import dependency	• Limited large-scale production technology (Lallinger et al., 2025)
	• Market potential for soy-free and sustainable products	• Variability of coconut raw materials (Chen et al., 2024)

Strengths

1. **Abundant and locally available raw material** - Coconut byproduct and widely available in coconut producing countries making them a sustainable and accessible resource (Samarajeewa, 2024).
2. **Potential protein source with functional properties** -Coconut protein contains valuable amino acids and functional components that can be used in food applications including emulsification and texture formation (Chen et al., 2024).
3. **Supports sustainability and waste utilization** -Recent studies show that plantbased byproduct can be utilized in TVP production, reducing food waste and improving sustainability (Lallinger et al., 2025).
4. **Soy free alternative (allergenic advantage)-** Coconut based TVP provides an alternative for individuals with soy allergies increasing inclusivity in plant-based diets (Boukid et al., 2024 concept supported).

Weaknesses

1. **Lower protein content compared to soy**- Coconut byproducts generally have lower protein levels than soy which may affect the structure and quality of TVP (Chen et al., 2024).
2. **Weaker protein network formation**-Studies indicate that increasing byproduct content can reduce protein network stability resulting in denser and less structured TVP (Lallinger et al., 2025).
3. **Limited existing research on coconut only TVP** -Most of the studies coconut with other proteins showing a gap in pure coconut based TVP development (Lallinger et al., 2025).
4. **Processing challenges (extrusion optimization needed)**-Oil and fiber content in coconut byproducts can affect extrusion behavior and final texture quality (Lallinger et al., 2025).

Opportunities

1. **Growing demand for plantbased meat alternatives-** The increasing shift of consumers toward plantbased diets creates the opportunities for alternative protein sources beyond soy (Boukid et al., 2024).
2. **Innovation in byproduct valorization-** Recent research emphasizes the potential of oil coconut for developing new food products like TVP (Nemli et al., 2025).
3. **Local economic development -**Utilizing the coconut byproducts can increase income for local farmers and reduce dependence on imported soy.
4. **Product differentiation** -Coconut based TVP can be marketed as allergen free, eco-friendly and locally sourced appealing to niche markets.

Threats

1. **Strong competition from established soy based TVP**-Soy remains the dominant raw material due to its high protein content and well established processing technologies.
2. **Consumer acceptance challenges-** Differences in taste, texture and aroma may affect market acceptance compared to traditional soy based products.
3. **Technical limitations in large scale production**-Most current studies are still at experimental or pilot scale limiting immediate commercialization (Lallinger et al., 2025).
4. **Variability of raw materials**-The composition of coconut byproducts can vary depending on processing methods affecting consistency and quality (Chen et al., 2024).

Research Gap

The SWOT analysis indicates that the coconut based Textured Vegetable Protein (TVP) has a strong potential as a sustainable but locally available and soy free alternative to conventional soy based products and its use of coconut byproducts and supports environmental sustainability and offers an inclusive option for consumers with soy allergies. However, the several challenges must be addressed to enhance its commercial viability including its relatively lower protein content and technical limitations in processing and the current lack of extensive research on its large scale production and performance. Addressing these issues is essential to fully maximize the potential of coconut-based TVP as a competitive meat substitute in the market.

METHODOLOGY

This section of the study introduces the methods used in conducting the study. This section also provides an overall summary of the tools used in generating and interpreting data.

Project Design

This study employs an experimental research design to develop and evaluate coconut based textured vegetable protein (TVP) as an alternative to traditional soy based TVP. The independent variable in this research is the method of protein extraction and texturization while the dependent variables include texture protein content, water absorption capacity and sensory acceptability.

Three treatment methods are investigated: **First Method** heat combined with alkaline texturization using sodium bicarbonate to modify protein structure and enhance elasticity **Second Method** acid induced coagulation to form curds from coconut milk simulating tofu like protein structuring and **Third Method** mechanical texturization with starch assistance to improve binding and create a fibrous meat like consistency. These methods are systematically compared to determine the most effective approach in producing a coconut based TVP with desirable physical, chemical and sensory properties.

Project Development

The development of coconut-based textured vegetable protein (TVP) requires the systematic selection and utilization of locally available raw materials and functional additives to achieve a meat like structure and acceptable sensory quality. The primary materials for this project are coconut byproducts, which serve as the main raw ingredient and include coconut milk residue grated or dried coconut meat, and coconut oil cake. These materials are essential as they provide the basic fibrous and residual protein components needed for TVP formation.

In addition to the coconut based raw materials several additives are required to enhance texture, binding ability and structural stability. Starch, either cassava or corn-based, is necessary as a binding and gelling agent to improve cohesion and simulate meat-like consistency. Sodium bicarbonate is included as an alkaline agent to modify protein structure and enhance elasticity during processing, while food grade acids such as vinegar or citric acid are essential for inducing coagulation in acid-based treatments. Furthermore, salt is incorporated to improve flavor and water is required as a medium for mixing, hydration, and proper processing of the

formulation. Together these materials form the foundation of the experimental development of coconut-based TVP as a sustainable alternative to soy-based protein products.

Project Development Process

This study uses an experimental research design to develop and evaluate coconut-based TVP as an alternative to common soy based TVP to determine what is the best methods or what is the most feasible method to make a tvp using coconut byproducts alternative to soy based protein for meat substitute using this three (3) Treatment methods:

1. Heat + Alkaline Texturization (Sodium Bicarbonate Method)
2. Acid-Induced Coagulation (Curd Formation Method)
3. Mechanical + Starch-Assisted Texturization

Raw Materials

1. Coconut byproducts:
2. Coconut milk residue (gata)
3. Coconut meat
4. Additives:
5. Starch cassava or corn as binder
6. Sodium bicarbonate an alkaline agent
7. Food grade acid like vinegar or citric acid
8. Salt and water

Test Procedure

Method 1: Alkaline Texturization Method using Sodium Bicarbonate

The alkaline texturization method using sodium bicarbonate works by altering the protein structure of coconut based materials allowing them to develop improved elasticity and a more fibrous consistency. Through this process the proteins partially unfold and realign resulting in a product with a firmer cohesive structure and as a result the final output is expected to exhibit a chewy texture and meat like elasticity making it more suitable as a plant based meat alternative.

Procedure (Alkaline Texturization Method)

The Coconut residue is dried first and ground into fine flour to ensure uniformity. The flour is then mixed with 20% water and 10% starch followed by the addition of 0.5–1% sodium bicarbonate as an alkaline agent. The mixture is kneaded thoroughly to form a cohesive dough. This dough is heated at 80–100°C while continuously mixing to promote protein modification and structure development. After heating the raw product is extruded or manually stretched to create a fibrous meat-like texture. Finally, the product is dried at 60°C for 6–8 hours to reduce moisture content and improve shelf stability.

Method 2: Acid Induced Coagulation Method (Curd Formation Method)

The acid induced coagulation or curd formation method this method relies on the putting of an acid such as vinegar or citric acid to coconut based mixtures in order to coagulate proteins and fats and similar to the process used in making tofu or cheese. It is important to take note that the sodium bicarbonate cannot be used in this method since it is alkaline and not acidic. When the acid is added and introduced it causes the proteins to denature and clump together forming soft curds. The expected result is a tenderand tofu like texture which can be further enhanced by pressing it or place an heavy object on the top of it to remove excess moisture or drying to achieve a firmer consistency.

Procedure (Acid-Induced Coagulation / Curd Formation Method):

First extracted and gently heated the fresh coconut milk to 70–80°C to prepare the proteins and fats for coagulation. An acid such as vinegar or citric acid is then added gradually while stirring it continuously until the visible curds begin to form. Once coagulation is completely the curds are separated by straining through a clean cloth and then pressed to remove excess liquid. To improve structure and binding 10–20% starch is incorporated into the curds. The mixture is then shaped as desired and subjected to heat drying or baking to achieve the preferred firmness and texture. For experimental formulation a 50:50 ratio of coconut milk and acidified solution may be used with the pH adjusted to approximately 4.5–5.5 to optimize curd formation and consistency.

Method 3: Mechanical + Starch Texturization

This method relies on the use of binding agents such as starch combined with manual or mechanical manipulation to create a fibrous structure that mimics meat. Instead of chemical modification the texture is developed through kneading stretching or shaping the mixture into strands. The expected outcome is a product with a noticeable fibrous consistency though it is less elastic compared to other methods. However, this approach is more affordable easier to perform and suitable for simple or small scale production.

Procedure (Mechanical/Texturization with Binding Agents)

Coconut flour is combined with water and starch in a ratio of 60%, 25% and 15%, respectively and mixed until a thick uniform paste is formed. The mixture is then kneaded thoroughly to help develop internal structure and improve binding. Once properly kneaded it is steamed for 20–30 minutes to gelatinize the starch and stabilize the matrix. After steaming the material is manually shredded or extruded to create a fibrous meat like appearance. Finally, the product is dried to reduce moisture and form stable TVP like chunks suitable for storage and later use.

Table 2. Ingredients for Coconut-Based TVP Production

Name of Ingredient	Figures	Quantity	Percentage (%)
Coconut Residue (gata)	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	700 g	70%
Starch (Cassava/Corn)	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears,...	150 g	15%
Water	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	120 ml	12%

Sodium Bicarbonate *(Method 1)*	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then...	10 g	1%
Vinegar/Citric Acid *(Method 2)*	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	10 ml	1%
Salt	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	10 g	1%
Total		**~1000 g**	**100%**

Table 3. Tools Used in Coconut-Based TVP Production

Tool Name	Figures	Quantity
Mixing Bowl	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	2
Measuring Cups/Spoons	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	1 set
Stirring Spoon/Spatula	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	3
Knife	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	1

Cutting Board	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	1
Strainer/Cheesecloth	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	1
Tray (for drying)	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	3

Table 4. Equipment Used in Coconut-Based TVP Production

Equipment Name	Figures	Function
Food Processor/Grinder	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	Grinds coconut materials into fine particles or flour
Stove	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	Provides heat for cooking and coagulation processes
Steamer	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	Used for steaming mixtures to develop texture

Oven/Dehydrator	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	Dries the product to achieve TVP form
Weighing Scale	The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.	Measures ingredients accurately

Schematic Diagram

The schematic diagram illustrates the overall methodology of the study in a step-by-step flow from raw materials to final output and evaluation. It begins with coconut-based raw materials combined with functional additives such as starch sodium bicarbonate acids salt and water. These inputs undergo project development and are processed through three experimental treatment methods: (1) heat and alkaline texturization (2) acid-induced coagulation and (3) mechanical and starch-assisted texturization. Each method is used to transform the coconut materials into a structured meat-like product through processes such as mixing kneading, heating steaming fiber formation and drying. The resulting product is a coconut-based TVP, which is then subjected to sensory evaluation by expert and student panelists using criteria such as appearance, flavor, aroma, texture, and overall acceptability.



Figure 4: Schematic Diagram

Evaluation Procedure

The sensory evaluation will be conducted with two groups of panelists 3–4 experts with a background in food processing and 30–50 student participants from Bulacan State University – Sarmiento Campus. Each participant will evaluate the coconut-based TVP sample under controlled conditions. Scores will be collected and analyzed using weighted mean to determine overall acceptability. Higher mean scores indicate greater preference and suitability as a meat substitute alternative to soybased protein.

Research instrument

This sensory evaluation questionnaire is designed to assess the acceptability of Coconut Based TVP in terms of Appearance, Flavor/Taste, Aroma, Texture and Overall Acceptability. The results will be used to determine whether coconut based protein can effectively serve as an alternative to soybased protein in meat substitute applications. Data gathered from the evaluation will be statistically analyzed using the weighted mean to determine the level of acceptability for each sensory attribute. The interpretation of results will be based on a 5-point hedonic scale where higher mean scores indicate greater product acceptability and stronger potential as a substitute for soy-based protein in meat alternative formulations.

Part I. Demographic Profile

Direction: Please check (✓) the appropriate answer.

1. Age

☐ 18–20 years old

☐ 21–30 years old

☐ 31–40 years old

☐ 41 years old and above

2. Gender

☐ Male

☐ Female

☐ Prefer not to say

3. Have you consumed plant-based meat products before?

☐ Yes

☐ No

4. Frequency of Consuming Plant-Based Products

☐ Daily

☐ Weekly

☐ Occasionally

☐ Rarely

☐ Never

5. Do you have allergies to soy products?

☐ Yes

☐ No

☐ Not sure

Part Ii. Product Development Evaluation

Instruction: Please evaluate the Coconut-Based Textured Vegetable Protein (TVP) by checking (✓) the score that best corresponds to your assessment.

Scale: 5 – **Excellent** | 4 – **Good** | 3 – **Acceptable** | 2 – **Poor** | 1 – **Unacceptable**

Scale	Description	Interpretation
5	Excellent	Like Extremely
4	Good	Like
3	Acceptable	Neither Like nor Dislike
2	Poor	Dislike Slightly
1	Unacceptable	Dislike Extremely

HEDONIC SCALE (5-POINT LIKERT SCALE

Sensory Evaluation of Coconut-Based Textured Vegetable Protein (TVP) as a Meat Substitute

Statement	5	4	3	2	1
The product has an appealing color.	☐	☐	☐	☐	☐
The product resembles meat in appearance	☐	☐	☐	☐	☐
The product presentation is attractive	☐	☐	☐	☐	☐

A. Appearance

Statement	5	4	3	2	1
The aroma of the product is pleasant.	☐	☐	☐	☐	☐
The smell is appetizing	☐	☐	☐	☐	☐
The product has no unpleasant odor	☐	☐	☐	☐	☐

B. Aroma

Statement	5	4	3	2	1
The product has a meat-like texture .	☐	☐	☐	☐	☐
The product has an acceptable chewiness.	☐	☐	☐	☐	☐
The product has a firm and fibrous structure	☐	☐	☐	☐	☐

C. Texture

Statement	5	4	3	2	1
The flavor of the product is acceptable.	☐	☐	☐	☐	☐
The seasoning level is balanced.	☐	☐	☐	☐	☐
The product has a pleasant aftertaste.	☐	☐	☐	☐	☐

D. Taste

E. Comparative Evaluation

Statement	5	4	3	2	1
The Coconut-based TVP can serve as an alternative to soy-based TVP	☐	☐	☐	☐	☐
The product resembles commercial soy-based TVP..	☐	☐	☐	☐	☐
The product performs well as a meat substitute.	☐	☐	☐	☐	☐

F. Sustainability and Market Acceptability

Statement	5	4	3	2	1
The product is acceptable as a sustainable food alternative.	☐	☐	☐	☐	☐
Using coconut by-product is a good waste to reduce food waste.	☐	☐	☐	☐	☐
I am willing to buy this product if commercially available	☐	☐	☐	☐	☐

G. Overall Acceptability

Part III. Open-Ended Questions

1. **What did you like most about the coconut-based TVP product?**

_____

_____

2. **What improvements can you suggest for the product?**

_____

_____

3. **Would you buy this product if sold in the market?**

☐ **Yes**

☐ **No**

☐ **Maybe**

4. **Additional comments/suggestions:**

_____

_____

Table 6: Time Table

Week	Activity
Week 1	Collection of materials
Week 2	Preparation of coconut raw materials
Week 3	Development of Method 1
Week 4	Development of Method 2
Week 5	Development of Method 3
Week 6	Identifying what Method is Best
Week 7	Pursuing Method 3 as Best Option
Week 8	Finalize the Process
Week 9	Testing and evaluation
Week 10	Data analysis
Week 10	Final documentation

Production Fabrication Cost

Method 1: Alkaline Texturization Method using Sodium Bicarbonate

Item	Quantity	Cost (PHP)
Coconut residue	2 kg	100
Starch	500 g	50
Sodium Bicarbonate	100 g	25
Electricity (drying/heating)	—	150
Labor	—	200
Total		**525 PHP**

Method 2: Acid Induced Coagulation Method (Curd Formation Method)

Item	Quantity	Cost (PHP)
Coconut residue / milk	2 kg	100
Vinegar/Citric Acid	250 ml	30
Starch	500 g	50
Electricity (heating)	—	120
Labor	—	200
Total		**500 PHP**

Method 3: Mechanical + Starch Texturization

Item	Quantity	Cost (PHP)
Coconut Milk	2 kg	100
Starch	500 g	50
Water	—	—
Electricity (steaming/drying)	—	130
Labor	—	200
Total		**480 PHP**

Statistician Certificate

This is to certify that the thesis study entitled: **"DEVELOPMENT AND EVALUATION OF COCONUT BY-PRODUCT-BASED TEXTURED VEGETABLE PROTEIN (TVP) AS AN ALTERNATIVE TO SOY-BASED MEAT SUBSTITUTES"**, prepared and submitted by: **ROMAY, ROGIELO IVAN M., SURUELA, JOEMAR V.,** in partial fulfillment of the requirements for the degree of Bachelor of Industrial Technology major in **Food Processing Technology,** has been statistically reviewed and evaluated by the statistician.

Abigail Bombaes, MAM

Statistician

DESCRIPTION AND EVALUATION OF THE COMPLETED PROJECT

The completed project used Method No. 3 (Mechanical + Starch-Assisted Texturization) to develop a coconut based Textured Vegetable Protein (TVP). This method was selected because it is simple cost effective and suitable for small scale production. The formulation consisted of coconut residue, starch, water and salt with starch serving as the binder and salt enhancing the flavor.

Ingredients Used

Ingredients	Quantity	Purpose
Coconut residue (gata)	700 g	Main raw material and protein source
Cassava/Corn starch	150 g	Binder and texturizing agent
Water	120 mL	Hydration and mixing medium
Salt	10 g	Flavor enhancement

Project Dimension

Project Dimension	Specification
Ingredient Preparation	1 hour (for 1 kg coconut residue/gata)
Cooking Time	1–2 minutes (cooking the coconut residue with starch)
Drying Temperature	60°C
Drying Time	1 hour per batch (using an oven or air fryer)
Total Estimated Processing Time	Approximately 2 hours and 2 minutes per batch

Figure 5. Schematic Diagram of the Production Procedure



Product Capabilities

The developed Coconut-Based Textured Vegetable Protein (TVP) is an innovative and sustainable plant-based meat alternative that offers several functional and commercial advantages.

1. Meat-Like Texture – Through Mechanical + Starch Assisted Texturization the product develops a fibrous texture that resembles conventional meat, making it suitable for various meat substitute applications.

2. Locally Available Raw Materials – The product utilizes coconut byproducts particularly coconut residue (gata), which are abundant in the Philippines promoting the efficient use of agricultural resources.

3. Sustainable Alternative – By converting coconut byproducts into value-added food products the project helps reduce food waste while supporting sustainable food production.

4. Soy-Free Meat Alternative – The product provides an alternative for consumers who have soy allergies or prefer non-soy plant-based protein products.

5. Cost-Effective Production – Method 3 requires simple equipment and ingredients making it practical for small-scale production and food processing enterprises.

6. Versatile Food Ingredient – The coconut based TVP can be incorporated into various food products such as burgers, meatballs, sausages, siomai, nuggets and other meat substitute dishes.

7. Consumer Acceptability – The product is evaluated based on appearance, aroma, taste, texture and overall acceptability to ensure consumer satisfaction.

8. Market Potential – With the increasing demand for plant-based foods, coconut based TVP offers an affordable, locally sourced and environmentally friendly alternative to conventional soy based TVP.

RESULTS OF THE PROJECT EVALUATION

Microbial Testing results

The report was certified by Mrs. Maribel Y. Martinez, PFT, Center-in-Charge, Analytical Testing Laboratory with the relevant FDA circular cited in the report. In simple terms our laboratory report is showing that our product Coconut-Based TVP sample PASSED the microbiological safety tests. This is useful evidence for your thesis Chapter 4/5 and for demonstrating the product's microbiological quality.The sample was tested for:

1. **Aerobic Plate Count (APC)**
2. **Total Coliform Count**
3. **Escherichia coli (E. coli)**
4. **Salmonella**
5. **Staphylococcus aureus**
6. **Yeast and Molds**

TABLE 1: TEST 1 RESULTS

Test	Actual Value	FDA Standard	Result
Aerobic Plate Count	**Less than 10 CFU/g**	Less than 10^4 CFU/g	**PASSED**
Total Coliform Count	**Less than 10 CFU/g**	Less than 50 CFU/g	**PASSED**

E. coli	**<2.2 MPN**	Less than 10 CFU/g	**PASSED**
Salmonella	**Not detected**	Absent/Not detected	**PASSED**
Staphylococcus aureus	**<2.2 MPN**	Less than 10 MPN	**PASSED**

TABLE 2 : TEST 2 RESULTS

Tests Performed	**Test Method**	**Results**	**Overall Interpretation**
Yeast and Mold Count	US FDA BAM Chapter 18	<10 CFU/g	**Passed / Acceptable***

Overall interpretation

The Coconut Based TVP passed all tested microbiological parameters with no detected Salmonella and acceptable levels of aerobic bacteria like coliforms, E. coli and Staphylococcus aureus that based on FDA standards. The yeast and mold count was <10 CFU/g, indicates a low microbial contamination and satisfactory in produuct microbiological quality test.

TABLE 3: Sensory parameters tested

Test Code	**Parameter**	**Test Method**	**Unit**	**Result**
P4249	Appearance	Organoleptic Evaluation	--	The chunks retain their regular cuboid shapes with well-defined geometric edges. They appear structurally firm, fibrous, and dry.
P4250	Color (Visual)	Organoleptic Evaluation	--	The outer surfaces exhibit deeper caramelized brown edges, while the internal fibers display a brighter, chalky ivory tint.
P4251	Taste	Organoleptic Evaluation	--	The sample exhibits a creamy, milky, coconut-like flavor profile with nutty notes and a rich, fatty/oily mouthfeel.
P4252	Odor	Organoleptic Evaluation	--	The aroma is characterized by strong roasted oil notes.
P4253	Texture	Organoleptic Evaluation	--	The sample exhibits a rough and hard texture with an oily surface feel when compressed between the fingers.

Sensory Evaluation

The sensory evaluation of the Coconut Based Textured Vegetable Protein (TVP) was conducted through organoleptic evaluation. The sensory characteristics assessed included appearance, color, taste, odor and texture. These parameters were evaluated to determine the sensory qualities of the developed coconut based tvp product. Appearance and color were assessed through visual observation, while taste, odor, and texture were examined to describe the overall sensory characteristics of the Coconut-Based TVP.

SURVEY RESULTS

This section presents the results of the sensory evaluation and market acceptability survey conducted to assess the developed coconut-based Textured Vegetable Protein (TVP) as a potential soy-free meat substitute. The evaluation was conducted among 60 respondents who assessed the product based on its appearance, aroma, texture, taste, comparative characteristics, sustainability and market acceptability, and overall acceptability. The respondents also provided information regarding their willingness to purchase the product if it were commercially available. The responses were analyzed using frequency, percentage, and weighted mean to determine the level of acceptability of the developed product. The results provide an assessment of how the respondents perceived the sensory qualities and potential market acceptance of the coconut-based TVP. The findings are presented according to the different criteria evaluated and are followed by their corresponding interpretations.

PART I. DEMOGRAPHIC PROFILE

Table 4: Age

Age	Frequency	Percentage
18–20 years old	46	76.67%
21–30 years old	14	23.33%
31–40 years old	0	0.00%
41 years old and above	0	0.00%
Total	**60**	**100%**

Interpretation:

Table 4 shows that the majority of the respondents were at aged of 18–20 years old with a frequency of 46 or 76.67%. Meanwhile 14 respondents or 23.33% were at aged of 21–30 years old. No respondents were aged of 31–40 years old or 41 years old and above. This indicates that most of the respondents were young adults.

Table 5: Gender

Gender	Frequency	Percentage
Male	22	36.66%
Female	37	61.67%
Prefer not to say	1	1.67%
Total	**60**	**100%**

Interpretation:

The Table 5 shows that the majority of the respondents those are females with a frequency of 37 or 61.67%. Meanwhile 22 respondents or 36.66% were male and 1 respondent or 1.67% preferred not to say. This indicates that most of the respondents were female.

Table 6: Have you consumed plant-based meat products before?

Response	Frequency	Percentage
Yes	30	50%
No	30	50%
Total	**60**	**100%**

Interpretation:

Table 6 shows that 30 respondents or 50% had consumed plant-based meat products before while the remaining 30 respondents or 50% had not. This indicates an equal distribution of respondents based on their previous consumption of plant-based meat products.

Table 7: Frequency of Consuming Plant-Based Products

Frequency	Frequency	Percentage
Daily	5	8.33%
Weekly	13	21.67%
Occasionally	12	20.00%
Rarely	14	23.33%

Never	16	26.67%
Total	**60**	**100%**

Interpretation:

Table 7 shows that the majority of the respondents never consumed plant based products with a frequency of 16 or 26.67%. Meanwhile 14 respondents or 23.33% rarely consumed plant based products while 13 or 21.67% consumed them weekly. This indicates that most respondents had limited experience consuming plant-based products.

Table 8: Do you have allergies to soy products?

Response	Frequency	Percentage
Yes	0	0%
No	54	90%
Not sure	6	10.00%
Total	**60**	**100%**

Interpretation:

Table 8 shows that the majority of the respondents had no allergies to soy products with a frequency of 54 or 90%. Meanwhile 6 respondents or 10% were not sure if they had soy allergies and none reported having allergies. This indicates that most respondents had no known soy allergies.

PART II. SENSORY EVALUATION

Scale:
5 = Excellent
4 = Good
3 = Acceptable
2 = Poor
1 = Unacceptable

A. Appearance

Statement	5	4	3	2	1	Weighted Mean
1. The product has an appealing color.	24	25	9	1	1	4.17
2. The product resembles meat in appearance.	44	13	2	0	1	4.65
3. The product presentation is attractive.	30	19	10	1	0	4.3
Category Mean						**4.37**

Interpretation: Excellent

Table A shows that the product's appearance was rated excellent with a category mean of 4.37. The statement "The product resembles meat in appearance" received the highest weighted mean of 4.65 while "The product has an appealing color" received the lowest at 4.17. This indicates that the product was visually appealing and resembled meat in appearance.

B. Aroma

Statement	5	4	3	2	1	Weighted Mean
1. The aroma of the product is pleasant.	36	15	7	1	1	4.4
2. The smell is appetizing.	35	16	6	2	1	4.37
3. The product has no unpleasant odor.	43	13	1	1	2	4.57
Category Mean						**4.44**

Interpretation: Excellent

Table B shows that the product's aroma was rated excellent with a category mean of 4.44. The statement "The product has no unpleasant odor" received the highest weighted mean of 4.57 while "The smell is appetizing" received the lowest at 4.37. This indicates that the product had a pleasant and appetizing aroma.

C. Texture

Statement	5	4	3	2	1	Weighted Mean
1. The product has a meat-like texture.	46	7	6	0	1	4.62
2. The product has an acceptable chewiness.	36	15	6	3	0	4.4
3. The product has a firm and fibrous structure.	39	13	5	1	2	4.43
Category Mean						**4.48**

Interpretation: Excellent

Table C shows that the product's texture was rated excellent with a category mean of 4.48. The statement "The product has a meat like texture" received the highest weighted mean of 4.62, while "The product has an acceptable chewiness" received the lowest at 4.40. This indicates that the product had a meat like firm and acceptable texture pleasant and appetizing aroma.

D. Taste

Statement	5	4	3	2	1	Weighted Mean
1. The flavor of the product is acceptable.	49	9	1	0	1	4.75
2. The seasoning level is balanced.	45	10	3	1	1	4.62
3. The product has a pleasant aftertaste.	39	13	5	1	2	4.43
Category Mean						**4.6**

Interpretation: Excellent

Table D shows that the product's taste was rated excellent with a category mean of 4.60. The statement "The flavor of the product is acceptable" received the highest weighted mean of 4.75 while "The product has a pleasant aftertaste" received the lowest at 4.43. This indicates that the product had an acceptable flavor balanced seasoning and pleasant aftertaste.

E. Comparative Evaluation

Statement	5	4	3	2	1	Weighted Mean
1. The Coconut-based TVP can serve as an alternative to soy-based TVP.	26	27	6	0	1	4.28
2. The product resembles commercial soy-based TVP.	28	29	9	2	1	4.17
3. The product performs well as a meat substitute.	36	17	3	3	0	4.46
Category Mean						**4.31**

Interpretation: Excellent

Table E shows that the product's comparative evaluation was rated excellent with a category mean of 4.31. The statement "The product performs well as a meat substitute" received the highest weighted mean of 4.46 while "The product resembles commercial soy based TVP" received the lowest at 4.17. This indicates that the Coconut based TVP was considered a suitable alternative to soy based TVP and performed well as a meat substitute.

F. Sustainability And Market Acceptability

Statement	5	4	3	2	1	Weighted Mean
1. The product is acceptable as a sustainable food alternative.	48	9	2	0	1	4.72
2. Using coconut by-product is a good way to reduce food waste.	42	15	1	2	0	4.62
3. I am willing to buy this product if commercially available.	43	13	3	1	0	4.63
Category Mean						**4.66**

Interpretation: Excellent

Table F shows that the product's sustainability and market acceptability were rated excellent with a category mean of 4.66. The statement "The product is acceptable as a sustainable food alternative" received the highest weighted mean of 4.72, while "Using coconut by product is a good way to reduce food waste" received the lowest at 4.62. This indicates that the Coconut-based TVP was highly acceptable as a sustainable food alternative and showed strong market potential.

G. Overall Acceptability

Statement	5	4	3	2	1	Weighted Mean
1. The coconut-based TVP is acceptable as a meat substitute.	42	14	3	1	0	4.62
2. I would recommend this product to others.	37	19	2	1	1	4.5
3. I am willing to consume or purchase this product again.	39	16	2	1	2	4.48
Category Mean						**4.53**

Interpretation: Excellent

Table G shows that the overall acceptability of the Coconut based TVP was rated excellent with a category

mean of 4.53. The statement "The coconut based TVP is acceptable as a meat substitute" received the highest weighted mean of 4.62 while "I am willing to consume or purchase this product again" received the lowest at 4.48. This indicates that the product was highly acceptable as a meat substitute and showed strong consumer willingness to recommend and purchase it again.

PART III. MARKET PURCHASE INTENTION

Would you buy this product if sold in the market?

Response	Frequency	Percentage
Yes	55	91.67%
No	1	1.67%
Maybe	4	6.67%
Total	**60**	**100%**

Interpretation:

The table shows that the majority of the respondents, 55 or 91.67%, were willing to buy the product if sold in the market. Meanwhile 4 respondents or 6.67% answered maybe while only 1 respondent or 1.67% answered no. This indicates that the Coconut based TVP has high consumer interest and strong market potential.

Overall Summary

Category	Mean	Interpretation
Appearance	**4.37**	Excellent
Aroma	**4.44**	Excellent
Texture	**4.48**	Excellent
Taste	**4.6**	Excellent
Comparative Evaluation	**4.31**	Excellent
Sustainability & Market Acceptability	**4.66**	Excellent
Overall Acceptability	**4.53**	Excellent
Overall Weighted Mean	**4.51**	**Excellent**

Interpretation

The results indicate that the developed coconut based Textured Vegetable Protein (TVP) was highly acceptable to the respondents, as shown by the overall weighted mean of 4.51, interpreted as Excellent. Among the evaluated categories of Sustainability and Market Acceptability obtained the highest weighted mean of 4.66 indicates that the respondents viewed to the product was positively in terms of its sustainability and utilization of the coconut byproducts and potential as a marketable food alternative. Furthermore the 91.67% of the respondents expressed their willingness to purchase the product if it were commercially available and suggesting a strong level of consumer interest and potential market acceptance. In overall the findings demonstrate that the coconut based TVP has favorable sensory qualities and promising potential as an alternative meat substitute.

SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This section of the paper delves on the summary of findings, conclusion and recommendations of the researchers.

Summary of findings

This study entitled as “Development and Evaluation of Coconut By-Product-Based Textured Vegetable Protein

(TVP) as an Alternative to Soy Based Meat Substitutes" aimed to develop a coconut based TVP using locally available coconut byproducts and evaluate its sensory acceptability, microbiological quality and market potential. This experimental research design was used to explore the three processing methods possible to make a tvp using coconut milk and Method 3 the Mechanical and Starch Assisted Texturization was selected for its simplicity, cost-effectiveness and suitability for small scale production. This product was made from coconut residue, starch, water and carrageenan then evaluated for the sensory qualities like microbiological safety and market acceptability.

Development of Coconut-Based Textured Vegetable Protein

The study was successfully developed a coconut based TVP using the Method 3 or Mechanical and Starch Assisted Texturization. The method involved the use of coconut residue, starch, water and salt to form a meat like textured product. The selected method was considered practical for small scale production because it required a simple ingredients and equipment. The production cost of Method 3 was recorded at ₱480.00, making it the least expensive among the three methods developed during product development and testing.

Microbiological Quality of the Developed Product

The microbiological testing results showed that the coconut-based TVP passed all tested microbiological parameters based on the standards stated in the laboratory report. These findings indicate that the tested sample had satisfactory microbiological quality under the conditions of the laboratory analysis

The product obtained the following results:

- Aerobic Plate Count: Less than 10 CFU/g.
- Total Coliform Count: Less than 10 CFU/g.
- Escherichia coli: Less than 2.2 MPN.
- Salmonella: Not detected.
- Staphylococcus aureus: Less than 2.2 MPN.
- Yeast and Mold Count: Less than 10 CFU/g.

Sensory Evaluation of the Coconut-Based TVP

The sensory evaluation for this coconut based tvp involving exactly 60 respondents who was carefully assessed the product using the five-point scale and the taste was obtained the highest mean of 4.60 while Sustainability and Market Acceptability received the highest category mean of 4.66. And the overall weighted mean was 4.51 interpreted as an Excellent.

Comparative Evaluation with Soy-Based TVP

The comparative evaluation obtained a category mean of 4.31, interpreted as Excellent. Respondents rated the coconut-based TVP positively as a meat substitute and alternative to soy-based TVP. The results indicate its potential as a promising soy-based TVP alternative.

Sustainability and Market Acceptability

The Sustainability and Market Acceptability category was obtained the highest weighted mean of 4.66 interpreted as Excellent. The respondents positively carefully evaluated the product as a sustainable food alternative with the mean of 4.72 for reducing food waste. And willingness to purchase obtained 4.63, indicating favorable market potential.

Overall Acceptability and Purchase Intention

The Overall Acceptability category obtained a weighted mean of 4.53 interpreted as Excellent and the respondents rated carefully the product positively as a meat substitute expressed willingness to recommend it to others and showed willingness to consume or purchase the product again. In terms of market purchase intention 55 out of 60 respondents, or 91.67%, answered Yes when asked if they would buy the product if sold in the market. One respondent or 1.67%, answered No while four respondents or 6.67%, answered Maybe. These results indicate a high level of interest in the developed coconut-based TVP among the respondents.

Conclusions

1. Development of Coconut-Based TVP

The study was successfully developed a coconut based TVP using the coconut by-] products and the Method 3 was selected for its simplicity, cost effectiveness and suitability for small scale production showing the potential of the coconut byproducts as an alternative TVP raw material.

2. Microbiological Quality

The coconut based TVP passed all the test of microbiological parameters indicating satisfactory quality based on laboratory standards. However, the results do not guarantee for the long term shelf life stability or the safety of future batches.

3. Sensory Acceptability

The coconut based TVP was highly acceptable with an overall weighted mean of 4.51, interpreted as an Excellent. Respondents gave the favorable evaluations of its sensory qualities, sustainability and market acceptability of the product

4. Alternative to Soy-Based TVP

The comparative evaluation obtained a weighted mean of 4.31 interpreted as an Excellent indicating that the coconut based TVP is a promising alternative to soy based TVP and plant based meat substitute.

5. Sustainability and Market Potential

The study concludes that the coconut based TVP has potential as a sustainable and locally sourced food alternative and meat alternative. Its sustainability and market acceptability mean of 4.66 and 91.67% purchase intention indicate favorable consumer interest.

6. Overall Conclusion

The study concludes that coconut byproducts can be utilized in the development of an acceptable textured vegetable protein through Mechanical and Starch Assisted Texturization. The developed coconut-based TVP demonstrated favorable sensory acceptability satisfactory microbiological results for the tested sample and promising market potential. Therefore, the product may serve as a potential locally sourced and soy-free alternative for meat substitute applications. Nevertheless, further studies are needed to establish its nutritional composition shelf stability large scale production feasibility and commercial performance before full commercialization.

Recommendations

1. Improvement of the Product Formulation Improve the texture, flavor, aroma and appearance by exploring different ingredient ratios.

2. Optimization of the Processing Methods Optimize kneading, steaming, drying and other processing conditions for the consistent product quality.

3. Nutritional Analysis Conduct nutritional testing and compare the product with commercial soy-based TVP.

4. Shelf-Life Testing Evaluate storage stability, packaging, and shelf life through further research.

5. Expanded Sensory Evaluation and Use a larger and more diverse group of respondents to assess the acceptability.

6. Comparison with Commercial Soy Based TVP Compare nutritional value, texture, cooking performance, cost and sensory qualities of the product.

7. Cost and Production Improvement Explore efficient of the production methods to reduce expenses and support small scale enterprises.

8. Food Safety and Quality Control and Maintain proper sanitation and conduct regular microbiological testing for product safety.

9. Commercialization and Market Testing and Conduct further studies on pricing, packaging, labeling, consumer demand and regulatory requirements.

10. Future Research Explore other coconut based materials and applications such as burgers, meatballs, nuggets and sausages to improve product quality and sustainability.

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