FORMULATION, ANALYSES, AND ACCEPTABILITY OF BREAD PRODUCTS WITH SOYA (*Glycine max*)

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Abstract: Bread is one of the most widely consumed staple foods worldwide, offering convenience, affordability, and nutritional benefits. This study evaluated the acceptability of adding soya flour into various bread products, such as ensaymada, cinnamon bread, and bread roll, which were developed using the soya flour with different proportions. This assessed the sensory qualities, general acceptability, microbial quality, proximate composition, and shelf life of bread products with soya. This also determined the differences in sensory attributes, such as appearance, aroma, taste, and texture among different treatments with varying levels of soya flour. Experimental design was used employing a completely randomized design with three treatments. Sensory qualities were conducted with 10 semi-trained panelists using 9-Point Hedonic Scale. Based on the result, all bread products with soya favored Treatment B with 20g of soya flour. The general acceptability showed that among the three treatments, consumers favored ensaymada. Sensory attributes were analyzed using ANOVA. The microbial and proximate analysis results confirmed that the soya bread products complied with food safety standards set by the Negros Prawn Producers Cooperative and Food and Drug Administration. The aerobic plate count, coliform count, Salmonella, molds and yeast count were all within acceptable limits, ensuring that the bread was safe for consumption. The shelf life evaluation revealed that mold growth began to appear between the seventh and fifteenth days, with an unpleasant odor developing by the later stages. By 15 days, visible mold spots were observed on all treatments, indicating a limited shelf life under normal storage conditions. The incorporation of soya flour into bread products improved both the sensory qualities and nutritional value. This highlights the potential for developing healthier bread alternatives using soya flour, while emphasizing the importance of proper formulation and storage to maintain product quality and consumer appeal.

Keywords: *Soya, Bread Products, Flour, Formulation, Analyses, Acceptability*

I.   INTRODUCTION

Bread is one of the most widely consumed staple foods worldwide, offering convenience, affordability, and nutritional benefits. Traditionally made from wheat flour, bread is a significant source of carbohydrates but is often limited in essential nutrients such as protein and fiber. To enhance its nutritional profile, researchers and food technologists have explored incorporating legume flour, particularly soy flour, into bread formulations (Gupta et al., 2020).

This study aimed to develop and analyze soya bread products, specifically ensaymada, cinnamon bread, and bread rolls, by evaluating their sensory properties and consumer acceptability. Additionally, it sought to determine the best formulation by assessing its nutritional content and microbial safety, ensuring the final product is both nutritious and safe to eat. According to Kumar and Verma (2022), understanding how people perceive and accept soya-enriched bread can contribute to the advancement of functional bakery products, catering to the increasing demand for healthier alternatives in the modern food industry.

This study was conducted to explore ways of improving the nutritional quality of bread by incorporating soya, a legume for high protein content and health benefits, and also evaluate the effects of adding a portion of soya flour on the nutritional composition, physical properties, and consumers' acceptability of bread products. By assessing its feasibility in bread production, this aimed to contribute to food innovation, promote healthier alternatives, and provide valuable insights for future researchers exploring plant-based protein sources in bakery applications.

Objectives of the Study

1.   The sensory qualities of bread products with soya in terms of appearance, aroma, taste, and texture;
2.   The general acceptability of bread products with soya in terms of sensory qualities among three treatments;

II.   METHODOLOGY

Phases	Description
Phase 1	Evaluation Design
Phase II	Experimentation
Phase III	Analysis

Methodology: Phase I Evaluation Design

❑   This study employed an experimental-developmental research design to evaluate the formulation, analyses, and acceptability of bread products with soya, specifically ensaymada, cinnamon bread, and bread roll. Zhao et al. (2023) posited that soy protein enhances the functional properties of food, mainly in terms of texture and protein quality. Also, Whang et al. (2021) noted that blending plant-based proteins, such as soy flour with wheat flour can improve the nutritional profile while maintaining desirable baking characteristics.

❑   The findings would provide valuable insights into the feasibility of using soya in bakery products, highlighting its potential to enhance the nutritional quality of traditional bread. Additionally, the study would contribute to sustainable food practices by utilizing plant-based protein sources to develop nutritious and acceptable bread products. The results would be significant to the bakery industry, offering a scientific basis for incorporating soya into bread formulations while ensuring consumer acceptance and nutritional enhancement.

Research Design

The experimental design for this study utilized a Completely Randomized Design (CRD) to evaluate the textural and sensory quality of bread enriched with soya flour, specifically ensaymada, cinnamon bread, and bread roll. The study involved three treatments: Treatment A (ensaymada), Treatment B (cinnamon bread), and Treatment C (bread roll) for each bread type, incorporating varying amounts of soya flour (A.O. Alamu, 2021).

Experimental Treatments

The experimental treatment for this study focused on incorporating varying proportions of soya flour (*Glycine max*) into different bread products, specifically ensaymada, cinnamon bread, and bread roll. The study aimed to determine the optimal level of soya flour substitution that maintains or enhances the sensory qualities and acceptability of the bread while improving its nutritional value.

Table 1 presents the proportion of ingredients used in making ensaymada across the three treatment variations (A, B, and C). The key variable in this study was the amount of soya flour incorporated into the dough, which differed among the treatments. Treatment A contained 10 grams of soya flour, Treatment B included 20 grams, and Treatment C had the highest amount at 30 grams. The formulations remained consistent in most ingredients, soya flour, all-purpose flour, sugar, yeast, salt, butter, milk, and eggs were kept at the same levels across all treatments.

Table 1. Proportion of ingredients used in making ensaymada among three treatments.

Ingredients	Treatment A (10g)	Treatment B (20g)	Treatment C (30g)
Soya Flour	10 grams	20 grams	30 grams
All-purpose Flour	250 grams	250 grams	250 grams
Sugar	50 grams	50 grams	50 grams
Yeast	5 grams	5 grams	5 grams
Salt	3 grams	3 grams	3 grams
Butter	65 grams	65 grams	65 grams
Milk	90 ml	90 ml	90 ml
Egg	52 grams	52 grams	52 grams
Ube Halaya	80 grams	80 grams	80 grams
Cheese	60 grams	60 grams	60 grams

Table 2, on the other hand, presents the proportion of ingredients used in making cinnamon bread across the three treatment variations (A, B, and C). Treatment A contained 10 grams of soya flour, Treatment B included 20 grams, and Treatment C had the highest amount at 30 grams. Likewise, the other ingredients were all in same measurements.

Table 2. Proportion of ingredients used in making cinnamon bread among three treatments.

Ingredients	Treatment A (10g)	Treatment B (20g)	Treatment C (30g)
Soya Flour	10 grams	20 grams	30 grams
All-purpose Flour	250 grams	250 grams	250 grams
Sugar	50 grams	50 grams	50 grams
Yeast	5 grams	5 grams	5 grams
Salt	3 grams	3 grams	3 grams
Butter	65 grams	65 grams	65 grams
Milk	90 ml	90 ml	90 ml
Egg	52 grams	52 grams	52 grams
Cinnamon Powder	15 grams	15 grams	15 grams
Butter	40 grams	40 grams	40 grams
Brown Sugar	22 grams	22 grams	22 grams

Table 3 presents the proportion of ingredients used in making bread roll across the three treatment variations (A, B, and C). The key variable in this study was the amount of soya flour incorporated into the dough, which differed among the treatments. Treatment A contained 10 grams of soya flour, Treatment B included 20 grams, and Treatment C had the highest amount at 30 grams. Likewise, the other ingredients were all in the same measurements.

Table 3. Proportion of ingredients used in making bread roll among three treatments.

Ingredients	Treatment A (10g)	Treatment B (20g)	Treatment C (30g)
Soya Flour	10 grams	20 grams	30 grams
All-purpose Flour	250 grams	250 grams	250 grams
Sugar	50 grams	50 grams	50 grams
Yeast	5 grams	5 grams	5 grams
Salt	3 grams	3 grams	3 grams
Butter	65 grams	65 grams	65 grams
Milk	90 ml	90 ml	90 ml
Egg	52 grams	52 grams	52 grams
Cheese	50 grams	50 grams	50 grams

III.   RESULTS AND DISCUSSION

Sensory Qualities of Bread Products with Soya

The sensory qualities of the bread products with soya (ensaymada, cinnamon bread and bread roll) as evaluated by the semi-trained panelists in terms of appearance, aroma, taste, and texture. Each treatment was rated using a 9-point hedonic scale, which scores were classified into various adjectival descriptions: Extremely Appealing (EA), Very Much Appealing (VMA), Extremely Pleasant (EP), Very Much Pleasant (VMP), Extremely Delicious (ED), and Very Much Delicious (VMD), Extremely Soft (ES), and Very Much Soft (VMS), among others. The mean scores for each sensory attribute (appearance, aroma, taste, and texture) across the three treatments were provided, as well as the corresponding adjectival descriptions.

 As to appearance of Treatment A (10g), ensaymada got the highest mean of 8.60 followed by bread roll with 8.50, while cinnamon bread got 8.20, with adjectival description of "Extremely Appealing", respectively. Similar results were obtained in terms of aroma, ensaymada got the highest mean 8.30, followed by cinnamon bread 8.20, while bread roll got 8.10 with adjectival description of "Extremely Pleasant", respectively. This showed that ensaymada outranked

cinnamon bread and bread roll. Furthermore, ensaymada was more pleasing than the two products, based on the evaluation of experts.

In terms of taste, both ensaymada and bread roll got the same high mean of 8.30, followed by cinnamon bread with mean of 8.10 with adjectival description of "Extremely Delicious", respectively. However, in terms of texture, cinnamon bread and bread roll got the same mean of 8.60, followed by ensaymada with 8.30 with adjectival description of "Extremely Soft". These data showed that the three products had a soft texture.

As to appearance of Treatment B (20g), cinnamon bread got the highest mean of 8.50, followed by ensaymada and bread roll with 8.40 with adjectival description of "Extremely Appealing". In terms of appearance, cinnamon bread was the highest among the three products based on the evaluation of the experts.

In terms of aroma, ensaymada, cinnamon bread, and bread roll got the same mean of 8.40 with adjectival description of "Extremely Pleasant". In terms of taste, cinnamon bread and bread roll got the same mean of 8.50, followed by ensaymada with 8.40 The delicious taste of the bread may be attributed to the better blending of all its ingredients.

In terms of the texture, bread roll got the mean of 8.50, which was highest, followed by ensaymada with 8.40, and bread roll with 8.30 with adjectival description of "Extremely Soft". The data showed that all the bread products with soya were very soft as to texture.

As to Treatment C (30g), in terms of appearance, cinnamon bread a got mean of 8.20, followed by ensaymada and bread roll with the same mean of 8.10 and adjectival description of "Very Much Appealing". In terms of aroma, cinnamon bread and bread roll got the same mean of 8.40 and ensaymada got 8.20, both with adjectival description of "Extremely Appealing".

In terms of taste, ensaymada and bread roll got the same mean of 8.00, followed by cinnamon bread with 7.80, both with adjectival description "Very Much Delicious". As to texture, ensaymada got the mean of 8.00, while cinnamon bread and bread roll got the same mean of 7.80, both with adjectival description of "Very Much Soft".

Generally, the proportion of the bread products was in favor to Treatment B (20g) (ensaymada, cinnamon bread and bread roll) with adjectival description of "Extremely Appealing" in terms appearance, "Extremely Pleasant" in terms of aroma, "Extremely Delicious" in terms of taste, and "Extremely Soft" in terms of texture. Overall, the table provided insights into how the proportions influenced the sensory qualities of bread products using soya flour, offering valuable information for product development.

The result of this study aligned to what Deng and Kim (2024) discussed on the opportunities and challenges of soy proteins in different food applications. They highlighted the nutritional benefits of soy protein, such as its high-quality amino acid profile and bioactive compounds. They also noted that excessive incorporation could impact texture and sensory qualities. This study was relevant to understanding the balance required when formulating bread products with soya. Similarly, Altunkaya et al. (2024) examined the incorporation of plant-based ingredients into bread, including soy-derived proteins. They found that while soy flour enhances the protein content, excessive amounts can negatively affect gluten network formation, leading to denser bread with altered sensory attributes.

Table 1. Sensory Qualities of Bread Products with Soya

Treatments		A (10g)		B (20g)		C (30g)	
Product	**Quality Attributes**	**Mean**	**AD**	**Mean**	**AD**	**Mean**	**AD**
	Appearance	8.60	EA	8.40	EA	8.10	VMA
1. Ensaymada	Aroma	8.30	EP	8.40	EP	8.20	EP
	Taste	8.30	ED	8.40	ED	8.00	VMD
	Texture	8.30	ES	8.40	ES	8.00	VMS
	Mean	**8.38**	**EAc**	**8.40**	**EAc**	**8.08**	**VMAc**
2.	Appearance	8.20	EA	8.50	EA	8.20	EA

Cinnamon Bread	Aroma	8.20	EP	8.40	EP	8.40	EP
	Taste	8.10	VMD	8.50	ED	7.80	VMD
	Texture	8.60	ES	8.30	ES	7.80	VMS
	Mean	**8.28**	**EAc**	**8.43**	**EAc**	**8.05**	**VMAc**
	Appearance	8.50	EA	8.40	EA	8.10	VMA
3. Bread Roll	Aroma	8.10	VMP	8.40	EP	8.40	EP
	Taste	8.30	ED	8.50	ED	8.00	VMD
	Texture	8.60	ES	8.50	ES	7.80	VMS
	Mean	**8.38**	**EAc**	**8.45**	**EAc**	**8.08**	**VMAc**

Score	Appearance	Aroma	Taste
8.12 – 9.00	Extremely Appealing (EA)	Extremely Pleasant (EP)	Extremely Delicious (ED)
7.23 – 8.11	Very Much Appealing (VMA)	Very Much Pleasant (VMP)	Very Much Delicious(VMD)
6.34 – 7.22	Moderately Appealing (MA)	Moderately Pleasant (MP)	Moderately Delicious (MD)
5.45 – 6.33	Slightly Appealing (SA)	Slightly Pleasant (SP)	Slightly Delicious (SD)

Score	Texture	Sensory Qualities
8.12 – 9.00	Extremely Soft (ES)	Extremely Acceptable (EAc)
7.23 – 8.11	Very Much Soft (VMS)	Very Much Acceptable (VMAc)
6.34 – 7.22	Moderately Soft (MS)	Moderately Acceptable (MAc)
5.45 – 6.33	Slightly Soft (SS)	Slightly Acceptable (SAc)

General Acceptability of Bread products with Soya

Acceptability of soya flour in three different treatments, evaluating key sensory attributes: appearance, aroma, taste, texture, and general acceptability. Each treatment was assessed on a 9-point hedonic scale, with score adjectival descriptions as "Liked Extremely" (LE), among others. The mean scores for each sensory attribute across the three treatments revealed some valuable insights regarding consumer preferences for bread products made with soya flour.

In terms of appearance, all three treatments, A (ensaymada), B (cinnamon bread), and C (bread roll) scored similarly with a mean of 8.47, which was classified as "Liked Extremely" (LE). This indicated that the visual qualities of the soya bread were consistently well-received across treatments, and the addition of soya flour did not negatively impact the bread's visual appeal. The high score for appearance implies that consumers prioritize the visual aspect of bread, which can influence their purchasing decisions. The result aligned with what Kadam et al. (2016) argued that soya flour could enhance the visual appearance of bread without detracting from its appeal.

In terms of aroma, Treatment A (ensaymada) received the highest mean score of 8.55, rated as "Liked Extremely" (LE), while Treatment B (cinnamon bread) scored 8.16 and Treatment C (bread roll) scored and 8.44, also rated as "Liked Extremely" (LE). This implies that Treatment A (ensaymada) was slightly more favorable in terms of aroma, although all treatments were generally considered pleasant. The aroma of the bread was likely influenced by the combination of soya flour and other ingredients, which contributed to the overall sensory experience. Similar findings were reported by Grewal et al. (2015), who noted that soya flour had a positive influence on the aroma of bread products, though the proportion of soya flour used could affect the intensity of the aroma.

For taste, Treatment A (ensaymada) achieved the highest mean score of 8.63, rated as "Liked Extremely" (LE), followed closely by Treatment B (cinnamon bread) with a score of 8.61, also rated as "Liked Extremely" (LE), while Treatment C (bread roll) had a slightly lower score of 8.46, still rated as "Liked Extremely" (LE). This implies that all treatments were highly favorable in terms of taste, with only a marginal difference between treatments. The favorable taste scores reflected the successful integration of soya flour into the bread, which likely contributed to an enhanced flavor profile,

as supported by prior research by Singh et al. (2017), who found that adding soya flour could improve the overall taste of bread without overpowering other flavors.

In terms of texture, Treatment B (cinnamon bread) scored the highest mean of 8.51, rated as "Liked Extremely" (LE), followed by Treatment A (ensaymada) with a score of 8.45, also rated as "Liked Extremely" (LE), while Treatment C (bread roll) received a slightly lower score of 8.29, rated as "Liked Extremely" but with a somewhat lower rating compared to Treatments A and B. The result implies that soya flour could effectively enhance the texture of bread, making it smooth and acceptable to consumers. The result agreed to what Singh et al. (2017) claimed the texture of bread is a critical sensory attribute, and soya flour has been known to contribute to a softer and finer crumb structure in bread products.

Table 2. General acceptability of brown rice chips with herbs

Quality Attributes	Treatment A (Ensaymada)		Treatment B (Cinnamon Bread)		Treatment C (Bread Roll)	
	Mean	AD	Mean	AD	Mean	AD
Appearance	8.47	LE	8.47	LE	8.47	LE
Aroma	8.55	LE	8.16	LE	8.44	LE
Taste	8.63	LE	8.61	LE	8.46	LE
Texture	8.45	LE	8.51	LE	8.29	LE
General Acceptability	**8.53**	**LE**	**8.44**	**LE**	**8.42**	**LE**

Legend: *Adjectival Description (AD)*

Score	General Acceptability
8.12 – 9.00	*Liked Extremely (LE)*
7.23 – 8.11	*Liked Very Much (LVM)*
6.34 – 7.22	*Liked Moderately (LM)*
5.45 – 6.33	*Liked Slightly (LS)*

IV.   CONCLUSION

Based on the sensory evaluation, it can be concluded that incorporating 20g of soya flour into ensaymada, cinnamon bread, and bread rolls results in the most well-received formulation. It highlights the effectiveness of soya flour in enhancing the sensory qualities of these baked products.

The consumer acceptability ratings highlight ensaymada as the most preferred formulation, particularly excelling in aroma, taste, and overall appeal. This confirms that soya flour can be successfully incorporated into bread products without compromising consumer satisfaction. Among the tested options, ensaymada with soya flour stand out as the most enjoyable choice, showcasing its potential to enhance both sensory and consumer appeal.

V.   RECOMMENDATION

Based on the findings of this study, the following recommendations are proposed to improve the sensory qualities, acceptability, and overall marketability of soya bread products:

Best consumption of bread products with soya, such as ensaymada, cinnamon bread, and bread roll is 20 grams of soya flour and is recommended for consumers' evaluation.

The findings on consumer acceptability suggest that soya flour can be successfully added into bread products without compromising consumer preferences. For mass production, further research is recommended to fine-tune the production process, ensuring consistent sensory quality across large batches. Innovations in automation and quality control systems may be implemented to maintain uniformity in appearance, aroma, taste, and texture while scaling up production.

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