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FORMULATION, ANALYSES AND ACCEPTABILITY OF PANDESAL WITH SQUASH AND SWEET POTATO LEAVES

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Abstract: Bread is a staple food globally, with various forms and formulations catering to different cultural and nutritional needs. This experimental-developmental study was conducted to incorporate functional and natural additives, such as mashed squash and powdered sweet potato leaves in making pandesal and determine its acceptability. This study used the Completely Randomized Design using three treatments in three replications. The first and second treatments were evaluated by 10 semi-trained panelists, who were food technology teachers, using the 9-Point Hedonic Scale. The final product (pandesal) was evaluated by 100 consumers. The statistical tools used to analyze the results were mean, Analysis of Variance, and post hoc test. The sensory qualities were evaluated in terms of appearance, aroma, taste, and texture. The findings revealed that in terms of appearance, Treatment C (85g squash, 15g sweet potato leaves) was extremely appealing; for aroma, Treatment B (90g squash, 10g sweet potato leaves) was extremely pleasant; for taste, Treatments A (95g squash, 5g sweet potato leaves) and B (10g squash & 10g sweet potato leaves) were extremely delicious; for texture, Treatments C (85g squash & 15g sweet potato leaves) and B (90g squash & 10g sweet potato leaves) were extremely soft. The consumers generally preferred Treatment A (95g squash, 5g sweet potato leaves) as they liked it extremely. There was no significant difference in the sensory qualities among three treatments. There was no significant difference in the consumers' acceptability, considering the sensory qualities. The shelf life of the pandesal with squash and sweet potato leaves in Treatments A, B, and C could last to one to three days when stored at room temperature and up to seven days when stored at chilling temperature with no changes in the sensory attributes.

Keywords: Squash, Sweet Potato, Pandesal, Formulation, Acceptability

I. INTRODUCTION

Bread is a staple food globally, with various forms and formulations catering to different cultural and nutritional needs. Pandesal, a traditional Filipino breakfast bread, has remained a popular choice due to its light texture and mild flavor, making it versatile for various pairings. However, increasing health consciousness and the growing demand for functional foods have encouraged the incorporation of nutrient-dense ingredients into bakery products.

Squash (Cucurbita spp.) and sweet potato (Ipomoea batatas) leaves are two underutilized, yet nutritionally rich vegetables. Squash is a rich source of beta-carotene, which contributes to its vibrant color and provides pro-vitamin A activity. Sweet potato leaves, on the other hand, are abundant in antioxidants, dietary fiber, and essential vitamins such as vitamin C and folates. Incorporating these ingredients into bread products aligns with efforts to enhance their nutritional value while introducing novel flavors and textures. Recent studies have explored the potential of fortifying baked goods with plant-based ingredients for added health benefits. For instance, squash puree has been shown to improve the sensory and nutritional qualities of muffins and bread when used in appropriate proportions (Ali et al., 2019). Similarly, powdered sweet potato leaves have been used as a functional ingredient in various food products, providing a natural source of antioxidants and improving overall acceptability (Lin et al., 2020).

This study investigated the acceptability of mashed squash and powdered sweet potato leaves in varying proportions in pandesal bread formulations. By evaluating sensory qualities, such as appearance, aroma, color, taste, and texture, this study aimed to provide a comprehensive understanding of how these formulations impact the bread's overall acceptability. Additionally, this included a shelf life assessment and microbial and proximate analyses to determine the product's safety and nutritional profile.

This study was conducted to incorporate functional and natural additives, such as mashed squash and powdered sweet potato leaves in making pandesal and determine its acceptability. Specifically, it aimed to; (1.) determine the sensory qualities of pandesal with squash and sweet potato leaves in terms of appearance, color, aroma, taste, and texture; (2.) determine the general acceptability of pandesal with squash and sweet potato leaves in terms of sensory qualities; (3.)



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determine if there is a significant difference in the sensory qualities of pandesal with squash and sweet potato leaves in three treatments in terms of appearance, aroma, color, taste, and texture; (4.) determine if there is a significant difference in the acceptability of pandesal with squash and sweet potato leaves in terms of sensory qualities among three treatments; (5.) determine the shelf life of pandesal with squash and sweet potato leaves at room temperature; and (6.) determine the microbial and proximate analyses of the best treatment of pandesal with squash and sweet potato leaves.

II. METHODOLOGY

Methodology: Methods of Research

This study used an experimental-developmental design to assess the acceptability and quality of pandesal with squash and sweet potato leaves. The primary objective was to evaluate the sensory qualities of the bread, such as appearance, aroma, color, taste, and texture, to determine if the added ingredients affect the bread's general acceptability.

Experimental Design

This study used the Completely Randomized Design (CRD) using three treatments . This design included three treatments with different proportions of mashed squash leaves and powdered sweet potato leaves, specifically Treatment A (95g mashed squash and 5g powdered sweet potato leaves), Treatment B (90g mashed squash and 10g powdered sweet potato leaves), and Treatment C (850g mashed squash and 15g powdered sweet potato leaves) per 500g of flour, alongside a control group consisting of traditional pandesal without any added leaves.

This study was experimental in nature, incorporating both sensory and objective analyses to assess the acceptability and quality of the bread. In the sensory evaluation, a group of semi-trained panelists evaluated the pandesal using a 9-Point Hedonic Scale for five attributes: appearance, aroma, color, taste, and texture. These sensory attributes helped determine the general acceptability of the different treatments. Additionally, a One-Way Analysis of Variance (ANOVA) was used to analyze any significant differences between the treatments, with post-hoc tests applied to identify which treatments significantly differ in terms of sensory quality. This statistical approach is vital in determining whether the addition of squash gourd and sweet potato leaves affects the sensory quality of the pandesal compared to the control.

In addition to sensory testing, the study assessed the shelf life and storage stability of the bread. The bread was stored at both room temperature and refrigerated conditions for a period of 7 days, with evaluations at intervals of 0, 2, 4, and 7 days to monitor any changes in texture, aroma, and appearance, as well as microbial growth. Microbial analysis was conducted to determine if the incorporation of these leaves influenced the bread's vulnerability to spoilage or contamination over time. Proximate analysis was also carried out on the best-performing treatment to evaluate the nutritional enhancement provided by the addition of squash gourd and sweet potato leaves. This involved testing key nutrients, such as moisture, protein, fat, fiber, and carbohydrates.

The study's objectives also included determining whether significant differences existed in the general acceptability and sensory quality of the treatments. The study aimed to provide new insights into the potential of enriching traditional pandesal with nutrient-dense plant materials, contributing to both the nutritional quality and shelf life of bread. This approach reflected the growing interest in the use of alternative and locally available natural ingredients to enhance food products and promote sustainable food systems. Through a robust experimental design, this study sought to determine the optimal combination of squash gourd and sweet potato leaves that maximizes both sensory appeal and nutritional value, supporting the development of a healthier bread option with potential market appeal.

Tools and Equipment

The tools and equipment used in the study were integral for both the preparation of the bread and the subsequent sensory and nutritional analysis. The study employed a variety of instruments to ensure consistency in both the baking process and the evaluation of the bread's properties.

Mixing Equipment. A stand mixer or hand mixer was essential for thoroughly combining the bread ingredients, ensuring that the mashed squash gourd and powdered sweet potato leaves were evenly distributed into the dough. Accurate measurement of ingredients, such as the specific amounts of squash and sweet potato leaves, was facilitated using measuring cups and spoons.



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Baking Tools. The pandesal with squash and sweet potato leaves was baked in an oven at a controlled temperature to achieve the desired texture and quality. Baking trays lined with parchment paper were used to place the dough, ensuring that the bread did not stick during the baking process.

Sensory Evaluation Tools. A 9-Point Hedonic Scale was utilized for sensory evaluation, where semi-trained panelists assessed the bread samples on key attributes, such as appearance, aroma, taste, and texture. Additionally, survey forms or questionnaires were used to systematically record the sensory evaluation results from the panelists, providing structured feedback on each treatment.

Storage and Shelf Life Tools. To evaluate the shelf life and storage stability of the pandesal with squash and sweet potato leaves, samples were stored in appropriate containers under controlled conditions. A refrigerator was used to store some samples to observe how they behave under cold storage, assessing whether the nutritional integrity and sensory qualities were maintained over time.

Ingredients Used in the Study

The ingredients used in the study were specifically chosen to assess the impact of adding natural, plant-based additives to the bread. These ingredients were the following:

All-purpose Flour. The all-purpose flour was the primary ingredient used in making pandesal with squash and sweet potato leaves. The flour provided the necessary structure and texture for the bread. It served as the main source of carbohydrates and gluten for the bread's development.

Water. The water was essential for hydrating the flour and activating the yeast, facilitating dough formation and fermentation. The amount of water used influenced the dough's consistency and elasticity.

Yeast. The yeast was a leavening agent that causes the dough to rise. It fermented the sugars present in the flour, releasing carbon dioxide gas that causes the bread to expand and develop a light, airy texture.

Sugar. The sugar was used to feed the yeast and promote fermentation. It also added sweetness to the bread and contributed to the maillard reaction during baking, which impacted the color and flavor.

Salt. The salt was added to enhance the flavor and regulate yeast activity, preventing over-fermentation. It also strengthened the dough's gluten network, contributing to the bread's texture.

Vegetable Oil. The vegetable oil or margarine was used to add moisture to the dough, improving its softness and shelf life. It contributed to the tender texture of the pandesal.

Mashed Squash. The squash were used as the main additive in the treatments. They were mashed to a fine consistency and incorporated into the dough. Squash leaves are rich in nutrients, including vitamins A and C, which can enhance the nutritional value of the bread.

Powdered Sweet Potato Leaves. The sweet potato leaves were dried and powdered for easy incorporation into the bread dough. Sweet potato leaves are rich in dietary fiber, vitamins, and minerals, providing additional health benefits to the bread.

Each treatment used different amounts of mashed squash and powdered sweet potato leaves, which vary from Treatment A (95g mashed squash and 5g powdered sweet potato leaves) to Treatment C 85g mashed squash and 15g powdered sweet potato leaves). These natural additives were expected to affect the sensory qualities (appearance, aroma, color, taste, and texture) and potentially enhance the nutritional profile of the pandesal, providing a healthier alternative without compromising the traditional qualities of the bread.

| Table 1. Proportion of ingredients for sensory evaluation. | | | | |
|--|-------------|-------------|-------------|--|
| Ingredients | Treatment A | Treatment B | Treatment C | |
| Mashed Squash | 95g | 90g | 85g | |
| Powdered Sweet Potato Leaves | 5g | 10g | 15g | |
| All-purpose Flour | 475g | 475g | 475g | |



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| Water (Lukewarm) | 220ml | 220ml | 220ml |
|---------------------------|-------|-------|-------|
| Yeast | 10g | 10g | 10g |
| Sugar (Refined) | 100g | 100g | 100g |
| Salt | 14g | 14g | 14g |
| Eggs | 150 g | 150g | 150 g |
| Soften Butter | 60g | 60g | 60g |
| Buttermilk/Powder Milk | 20g | 20g | 20g |
| Sugar | 10g | 10g | 10g |

Experimental Procedure

The experimental procedure for this study involved a systematic and standardized approach in preparing and presenting the pandesal with squash and sweet potato leaves. The step-by-step process ensured consistency across all treatments and minimized potential variations that could impact the results.

Step 1. Preparing of Mashed Squash. The procedure for preparing mashed squash for this study began with selecting the fresh, ripe squash that are free of blemishes, mold, or damage. The squash was thoroughly washed under running water to remove dirt and residues. Once cleaned, the squash was peeled using a sharp knife or vegetable peeler, and then cut into small, uniform chunks to facilitate even cooking. These chunks were then placed in a pot with enough water to submerge them completely. The water was then brought to a boil over medium heat and the squash was boiled for about 15-20 minutes or until it became tender and could be easily pierced with a fork. After boiling, the water was drained from the squash using a colander, and the squash was left to cool slightly.

Next, the boiled squash was mashed using a potato masher or fork until it reached a smooth, uniform consistency, free from lumps. If necessary, the mashing was continued to achieve the desired texture. The mashed squash was then measured according to the specific quantities required for each treatment, with Treatment A requiring 95g, Treatment B requiring 90g, and Treatment C requiring 85g of mashed squash. A digital scale was used to ensure accuracy in measurement. If not immediately used, the mashed squash was stored in an airtight container and refrigerated if it is to be kept for more than a few hours, ensuring it remained fresh and suitable for use within 24 hours.

This procedure ensured consistent preparation of mashed squash, providing reliable results when incorporated into the pandesal dough for the experimental treatments. The smooth texture of the mashed squash was the key to assessing its impact on the sensory qualities of the bread, such as appearance, texture, and taste. The proper hygiene practices were followed throughout the process to maintain the quality and safety of the food product.

Step 2. Preparing of Powdered Sweet Potato Leaves. The preparation of powdered sweet potato leaves started by selecting young and tender sweet potato leaves.

These leaves were washed thoroughly to remove dirt and any other impurities. They were dried then, either by air drying in a shaded area or by using an oven or dehydrator at a low temperature to ensure proper dehydration without damaging the leaves. Once completely dry, the leaves were grounded using a grinder or a high-powered blender to achieve a fine powder consistency. The powder was sifted through a fine mesh sieve to eliminate any coarse particles. The powdered sweet potato leaves were then ready for incorporation into the dough of each treatment at the prescribed proportions.

Step 3. Making of Pandesal Bread. In making the pandesal, the basic ingredients, such as the all-purpose flour, water, yeast, sugar, salt, and vegetable oil were mixed in a large bowl. The mixture was then blended to form a basic dough. Subsequently, the pre-prepared mashed squash leaves and powdered sweet potato leaves were added in varying amounts for each treatment: Treatment A (95g mashed squash and 5g powdered sweet potato leaves); Treatment B (90g mashed squash and 10g powdered sweet potato leaves); and Treatment C (85g mashed squash and 15g powdered sweet potato leaves). The dough was kneaded for 10 to 15 minutes until it became smooth and elastic, and it was left to rest for 1-2



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hours to rise. After the dough had doubled in size, it was punched down, divided into small portions, and shaped into round balls. Each dough ball was then rolled in breadcrumbs to coat before being arranged on a baking tray. The pandesal was then baked in a preheated oven at 180°C (350°F) for 15 to 20 minutes or until golden brown. Once baked, the pandesal was allowed to cool on a wire rack before being evaluated.

Step 4. Evaluating the Pandesal. In the sensory evaluation, a panel of semi-trained evaluators assessed the pandesal based on several sensory attributes, such as appearance, aroma, color, taste, and texture. Each evaluator was provided with samples from the three treatments and asked to score each sensory attribute on a pre-defined scale. This evaluation provided insight into the perceived quality of the pandesal. Additionally, general acceptability was assessed using a 9-Point Hedonic Scale, which evaluators indicated their overall preference for each treatment based on all sensory attributes combined. The results of these evaluations were then compiled to determine which treatment yielded the most favorable outcomes.

Step 5. Shelf Life and Storage Stability Testing. For testing the shelf life and storage stability, samples of the dough (before baking) were stored at room temperature. After baking, the pandesal was also stored for up to 7 days. During this time, evaluations were conducted to monitor changes in texture, flavor, and aroma. The results of this storage stability testing helped determine the optimal conditions for maintaining the freshness and quality of the pandesal enriched with squash and sweet potato leaves.

Step 6. Microbial and Proximate Analysis. The microbial analysis was conducted on the best-performing treatment of pandesal with squash and sweet potato leaves with, as identified through the sensory evaluation by the Department of Science and Technology (DOST) Iloilo Laboratory, Iloilo City. Microbial tests, such as the total viable count, yeast and mold count, and coliform count, were performed to ensure that the product was safe for consumption and to assess the effectiveness of storage methods in preventing microbial growth. This analysis was crucial for evaluating the bread's safety and overall quality. The certification was then given to identify the analysis

| Preparing of Mashed Squash | | | | |
|---|--|--|--|--|
| | | | | |
| Preparing of Powdered Sweet Potato Leaves | | | | |
| | | | | |
| Making of Pandesal Bread | | | | |
| | | | | |
| Evaluating the Pandesal | | | | |
| | | | | |
| Shelf Life and Storage Stability Testing | | | | |
| | | | | |
| Microbial and Proximate Analysis | | | | |
| Figure 4. Flow chart in preparing the pandesal with squash and sweet potato leaves. | | | | |



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Figure 5. Flow chart in preparing the mashed squash



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Figure 6. Flow chart in preparing the powdered sweet potato leaves



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Figure 7. Flow chart in preparing and making of pandesal.

III. RESULTS AND DISCUSSION

These samples underwent sensory evaluation by the semi-trained evaluators, who assessed the product based on predefined attributes. Evaluators were provided with scores on a scale, ranging from poor to excellent to determine the overall acceptability of each treatment. The goal was to identify potential issues in dough preparation, baking, and sensory qualities, such as appearance, texture, taste, aroma, and color. Small batches of pandesal were baked using three formulations: Treatment A (95 g mashed squash and 5g powdered sweet potato leaves); Treatment B (90g mashed squash and 10g powdered sweet potato leaves); and Treatment C (85g mashed squash and 15g powdered sweet potato leaves).

The sensory evaluation took place in a controlled environment to minimize bias, ensuring that each participant has equal access to the samples. The data collected were analyzed to determine the preferences for each treatment and identify any significant differences in sensory qualities. The initial evaluation helped determine if adjustments were needed to improve the texture, aroma, flavor, or appearance. Potential issues identified during the pilot testing included dense texture, overpowering aroma of sweet potato leaves, a darker color of the bread, and strong flavors that might not appeal to all consumers.

To address these issues, adjustments were made, such as reducing the amount of mashed squash gourd and powdered sweet potato leaves, adding spices to balance the aroma, or incorporating natural food coloring to enhance the visual appeal.

If the texture is too dense, the flour and liquid ratio may be modified to achieve a lighter and fluffier bread. Similarly, the yeast quantity or proofing time may be adjusted to ensure the dough rises properly. Once revisions are made, the formulations would be re-baked and tested again, with further adjustments as necessary. The revised formulations underwent another round of sensory evaluation to assess improvements and confirm acceptability.



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Finally, once the product met the desired sensory standards, a final round of evaluation was conducted, including microbial and proximate analyses. This determined whether the product is ready for large-scale production or further development. The pilot testing and revision process was the key to ensuring that the product is both nutritious and acceptable to consumers, aligning with the research objectives and offering an innovative alternative to traditional pandesal.

Scoring of Variables

The 9-Point Hedonic Scale was used for scoring the sensory variables. This scale allowed the evaluators to rate the attributes based on their level of liking or disliking.

For the Sensory Qualities of the Product:

| Scoring Interval | Quality Description |
|------------------|--|
| 8.12 - 9.00 | Extremely Appealing |
| 7.23 - 8.11 | Very Much Appealing |
| 6.34 - 7.22 | Moderately Appealing |
| 5.45 - 6.33 | Slightly Appealing |
| 4.56 - 5.44 | Neither Like nor Disliked |
| 3.67 - 4.55 | Slightly not Appealing |
| 2.78 - 3.66 | Moderately not Appealing |
| 1.89 - 2.77 | Very Much not Appealing |
| 1.0 - 1.88 | Extremely not Appealing |
| | |
| Scoring Interval | Quality Description |
| 8.12 - 9.00 | Extremely Pleasant |
| 7.23 - 8.11 | Very Much Pleasant |
| 6.34 - 7.22 | Moderately Pleasant |
| 5.45 - 6.33 | Slightly Pleasant |
| 4.56 - 5.44 | Neither Pleasant nor Unpleasant |
| 3.67 - 4.55 | Slightly Unpleasant |
| 2.78 - 3.66 | Moderately Unpleasant |
| 1.89 - 2.77 | Very Much Unpleasant |
| 1.0 - 1.88 | Extremely Unpleasant |
| | Scoring Interval 8.12 - 9.00 7.23 - 8.11 6.34 - 7.22 5.45 - 6.33 4.56 - 5.44 3.67 - 4.55 2.78 - 3.66 1.89 - 2.77 1.0 - 1.88 Scoring Interval 8.12 - 9.00 7.23 - 8.11 6.34 - 7.22 5.45 - 6.33 4.56 - 5.44 3.67 - 4.55 2.78 - 3.66 1.89 - 2.77 1.0 - 1.88 |

3. Color

| Score | Scoring Interval | Quality Description |
|----------|------------------|-------------------------------------|
| 9 | 8.12 - 9.00 | Extremely Authentic |
| 8 | 7.23 - 8.11 | Very Much Authentic |
| 7 | 6.34 - 7.22 | Moderately Authentic |
| 6 | 5.45 - 6.33 | Slightly Authentic |
| 5 | 4.56 - 5.44 | Neither Authentic nor Not Authentic |
| 4 | 3.67 - 4.55 | Slightly Not Authentic |
| 3 | 2.78 - 3.66 | Moderately Not Authentic |
| 2 | 1.89 - 2.77 | Very Much Not Authentic |
| 1 | 1.00 - 1.88 | Extremely Not Authentic |
| 4. Taste | | |
| Score | Scoring Interval | Quality Description |
| 9 | 8.12 - 9.00 | Extremely Delicious |
| 8 | 7.23 - 8.11 | Very Much Delicious |
| 7 | 6.34 - 7.22 | Moderately Delicious |
| 6 | 5.45 - 6.33 | Slightly Delicious |
| 5 | 4.56 - 5.44 | Neither Like nor Disliked |
| 4 | 3.67 - 4.55 | Slightly not Delicious |
| 3 | 2.78 - 3.66 | Moderately not Delicious |



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| 2 | 1.89 - 2.77 | Very Much not Delicious |
|---|-------------|-------------------------|
| 1 | 1.00 - 1.88 | Extremely not Delicious |

5. Texture

3

2

1

| Score | Scoring Interval | Quality Description |
|-------------------|--------------------------|--------------------------------|
| 9 | 8.12 - 9.00 | Extremely Soft |
| 8 | 7.23 - 8.11 | Very Much Soft |
| 7 | 6.34 - 7.22 | Moderately Soft |
| 6 | 5.45 - 6.33 | Slightly Soft |
| 5 | 4.56 - 5.44 | Neither Like Nor Disliked Soft |
| 4 | 3.67 - 4.55 | Slightly Not Soft |
| 3 | 2.78 - 3.66 | Moderately Not Soft |
| 2 | 1.89 - 2.77 | Very Much Not Soft |
| 1 | 1.00 - 1.88 | Extremely not soft |
| 6. For the Accept | ptability of the Product | |
| Score | Scoring Interval | Qualitative Description |
| 9 | 8.12 - 9.00 | Liked Extremely |
| 8 | 7.23 - 8.11 | Liked Very Much |
| 7 | 6.34 - 7.22 | Liked Moderately |
| 6 | 5.45 - 6.33 | Liked Slightly |
| 5 | 4.56 - 5.44 | Neither Like nor Disliked |
| 4 | 3.67 – 4.55 | Disliked Slightly |
| | | |

2.78 – 3.66 Disliked Moderately

1.00 - 1.88

Disliked Extremely

Instrumentation

This study involved several steps to ensure that the sensory evaluation tool used to measure the acceptability of pandesal with squash and sweet potato leaves reliable and accurate. First, the 9-Point Hedonic Scale, which assessed sensory attributes, such as appearance, aroma, color, taste, and texture, was reviewed by experts in food technology. These experts ensured that the scale was appropriate and the descriptions were clear and relevant to the study's objectives.

Lastly, sensory evaluation was carried out using the 9-Point Hedonic Scale, which participants evaluated the three treatments (A, B, and C) of pandesal. Subsequently, statistical analysis was used to check for internal consistency. Content validity was also ensured by confirming that the sensory attributes on the scale comprehensively capture the important qualities of the pandesal, such as appearance, aroma, color, taste, and texture. Any feedbacks gathered from the pre-testing and expert reviews were used to refine and improve the instrument, such as adjusting the wording of the scale or clarifying descriptions. Through these steps, the validation process ensured that the instrument accurately measured the sensory qualities and acceptability of the pandesal, producing reliable, consistent, and valid results.

Data Collection

Data collection for this study involved gathering both the sensory and analytical data to evaluate the acceptability of pandesal with squash gourd and sweet potato leaves. The sensory evaluation was the primary method of data collection, which the semi-trained evaluators and untrained participants were selected to assess the three different treatments of



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pandesal (Treatment A: 95g mashed squash and 5g powdered sweet potato leaves; Treatment B: 90g mashed squash and 10g powdered sweet potato leaves; and Treatment C: 85g mashed squash and 15g powdered sweet potato leaves) using a 9-Point Hedonic Scale. This scale assessed sensory attributes, such as appearance, aroma, color, taste, and texture, with each participant scoring these characteristics based on their preferences.

The data for each treatment were collected in separate sessions to ensure that the evaluators evaluated the pandesal independently and without bias. The evaluation took place in a controlled environment, where the samples were served in random order to prevent any order effects from influencing the participants' responses. After the sensory evaluation, the data collected from the ratings were analyzed to determine the general acceptability of the treatments and identify any significant differences between the treatments in terms of sensory qualities.

Additionally, to assess the shelf life and storage stability of the pandesal, samples were stored under defined conditions before and after baking, and periodic evaluations were made over time to monitor changes in quality. Proximate analysis and microbial testing were also conducted on the best-performing treatment to evaluate the nutritional content and safety of the pandesal by sending the product to the Department of Science and Technology (DOST) Iloilo Laboratory.

All data were carefully recorded, analyzed statistically, and used to draw conclusions regarding the impact of mashed squash leaves and powdered sweet potato leaves on the acceptability and quality of pandesal, with focus on understanding how these ingredients influenced the sensory and storage characteristics of the bread.

Statistical Tools and Analysis

The statistical tools and analysis for this study primarily involved descriptive and inferential statistics to evaluate the sensory acceptability and other quality attributes of the pandesal enriched with mashed squash and powdered sweet potato leaves. Descriptive statistics, such as means, standard deviations, and frequency distributions, were used to summarize the sensory ratings for each treatment across the five attributes: appearance, aroma, color, taste, and texture. These statistics provided a clear understanding of the general trends and preferences of the evaluators.

To determine whether there were significant differences between the three treatments in terms of sensory quality and general acceptability, inferential statistical methods were employed. A One-Way Analysis of Variance (ANOVA) was used to compare the mean scores of the three treatments for each sensory attribute (appearance, aroma, color, taste, and texture). The ANOVA helped identify whether the differences observed in the sensory ratings were statistically significant. If the ANOVA revealed significant differences, post-hoc tests, such as Tukey's Honest Significant Difference (HSD) test, were used to pinpoint which specific treatment(s) differed from the others.

Additionally, to assess the nutritional composition and microbial safety of the best-performing pandesal treatment, the data from proximate and microbial analyses were summarized and compared to standard values for bread. Descriptive statistics were used to report the nutritional composition (protein, fat, fiber content) and microbial load, and statistical tests were applied to evaluate the safety and quality consistency of the bread.

All data analyses were performed using statistical software, such as SPSS or R, with a significance level set at p < 0.01 to determine the statistical significance of the results.

Cost Analysis

The cost analysis of the ingredients used in the study on pandesal with mashed squash leaves and powdered sweet potato leaves is presented in Table 2. The table provides a breakdown of the unit cost, quantity used per treatment, and the total cost per treatment for each ingredient.

From the table, it is clear that the costs associated with the added ingredients (mashed squash gourd and powdered sweet potato leaves) were relatively low compared to the core ingredients (flour, yeast, sugar, salt, and water). However, these additional ingredients provided value in terms of nutritional enhancement, flavor, and potential appeal to health-conscious consumers. The overall cost per treatment varied depending on the quantity of these special ingredients used, but the bread remained affordable while offering potential functional benefits. The study also explored the cost-effectiveness of using these ingredients in comparison to conventional pandesal, providing insights into both economic and nutritional advantages.



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| Table 2 | Cost analysis |
|------------|---------------|
| I a D C Z. | |

| 1 uolo 2. Cost analysis. | | | | | |
|---------------------------------|------------|------------------|-------------------------------|----------------------------------|--|
| Ingredients | Unit | Cost per Unit | Quantity per Treatment | Total Cost per Treatment | |
| All-purpose flour | 1 kg | ₱40 - ₱50 | 500g | ₱20 - ₱25 | |
| Yeast | 10g packet | ₱15 - ₱25 | 10g | ₱7.5 - ₱12.5 | |
| Sugar | 1 kg | ₱50 - ₱60 | 110g | ₱2.5 - ₱3 | |
| Salt | 1 kg | ₱15 - ₱20 | 5g | ₱0.075 - ₱0.1 | |
| Water | 1 liter | ₱5 - ₱10 | 250ml | ₱1.25 - ₱2.5 | |
| Mashed Squash Leaves | per bundle | ₱10 - ₱20 | 95g, 90g, 85g (per treatment) | ₱2 - ₱6 (depending on treatment) | |
| Powdered Sweet Potato Leaves | per bundle | ₱10 - ₱20 | 5g, 10g, 15g (per treatment) | ₱1 - ₱4 (depending on treatment) | |

Total Cost per Treatment

- Treatment A (95g mashed squash + 5g powdered sweet potato leaves):
 - o Total: ₱46.10/ 500g
 - o ₱1.10/pc
- Treatment B (90g mashed squash 1 + 10g powdered sweet potato leaves):
 - o Total: ₱48.60/500g
 - o ₱ 1.15/pc
- Treatment C (85g mashed squash leaves + 15g powdered sweet potato leaves):
 - o Total: ₱51.10/500g
 - o ₱1.20/pc

Sensory Qualities of Pandesal with Squash and Sweet Potato Leaves among Three Treatments

Table 3 reflects the sensory qualities of pandesal with squash and sweet potato leaves among three treatments in terms of appearance, color, aroma, taste, and texture.

The result revealed that, in terms of appearance, Treatment C (85g squash & 15g sweet potato leaves) was found "Extremely Appealing" with a mean score of 8.30. This means that regardless of the amount of mashed squash gourd and powdered sweet potato leaves in making pandesal it did not affect the appearance of the product as a whole. While, in terms of aroma, Treatment B (90g squash & 10g sweet potato leaves) was "Extremely Pleasant" as revealed by the mean score of 8.30. This implies that the aroma of the three treatments was the same regardless of the amount of mashed squash gourd and powdered sweet potato leaves in making pandesal. Further, the taste of the product in Treatments A (95g squash & 5g sweet potato leaves and B (90g squash & 10g sweet potato leaves) was "Extremely Delicious" with the highest mean score of 8.30. As to the texture of the product, Treatment C (85g squash & 15g sweet potato leaves) with the mean of 8.40 and Treatment B (90g squash & 10g sweet potato leaves) with the mean of 8.20 were rated as "Extremely Soft".

The result implies that in the context of incorporating functional ingredients into bread products, sensory quality plays a crucial role in consumer acceptance. Sensory characteristics, such as appearance, aroma, color, taste, and texture are key determinants of overall consumer satisfaction.

The result agreed to what Gupta and Kumar (2022) argued that bread enriched with vegetable ingredients, like squash gourd and sweet potato leaves, often presents unique sensory attributes that can either appeal to or deter consumers, depending on the formulation. For instance, the addition of squash gourd can enhance the color and moisture of bread due to its high water content, leading to a softer texture and potentially a sweeter flavor. According to Tung et al. (2022), sweet potato leaves have been shown to contribute to the sensory qualities of bread. By incorporating powdered sweet potato leaves into bread dough, its green color, mild bitterness, and delicate earthy aroma enhance the sensory profile of the bread, though adjustments in formulation are necessary to balance these characteristics. Additionally, a study by Ginting et al. (2020) highlighted that the incorporation of vegetables like pumpkin and squash into bread resulted in a noticeable change in texture and flavor, which was positively received when used in moderate quantities.



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According to Olaove et al. (2021), the texture and mouthfeel, for example, may be influenced by the moisture content of the vegetables, while the aroma and taste can reflect the vegetable's inherent flavor profile. The addition of sweet potato flour in bread was found to enhance its nutritional profile, especially with respect to fiber and antioxidants, but it could slightly alter the bread's texture and taste depending on the proportion used.

Table 3. Sensory qualities of pandesal with squash and sweet potato leaves among three treatments in terms of appearance, color, aroma, taste, and texture.

| | | | ſ | Treatments | | |
|-------------------|------|-----|------|-------------------|------|-----|
| | | Α | | В | | С |
| Sensory Qualities | Mean | AD | Mean | AD | Mean | AD |
| Appearance | 8.00 | VMA | 8.10 | VMA | 8.30 | EA |
| Aroma | 7.70 | VMP | 8.30 | EP | 7.80 | VMP |
| Taste | 8.30 | ED | 8.30 | ED | 7.80 | VME |
| Texture | 8.00 | VMS | 8.20 | ES | 8.40 | ES |
| Grand Mean | 8.00 | | 8.23 | | 8.08 | |

Adjectival Description

Legend: EA- Extremely Appealing

EP - Extremely Pleasant

ED - Extremely Delicious

ES - Extremely Soft

VMA -Very Much Appealing VMP - Very Much Pleasant VMS - Very Much Savory VMS - Very Much Soft VMD – Very Much Delicious

General Acceptability of Pandesal with Squash and Sweet Potato Leaves

Table 4 shows the general acceptability of pandesal with squash and sweet potato leaves in terms of sensory qualities. The result revealed that in terms of appearance, (Treatment A) with the mean score of 8.40 and (Treatment B) with the mean score of 8.15 were "Liked Extremely," while (Treatment C) with the mean score of 8.10 was "Liked Very Much". In terms of aroma, all the products were interpreted as "Liked Very Much" with (Treatment A) with the mean score of 8.05, (Treatment B) with the mean score of 7.93, and (Treatment C) with the mean score of 7.81. In terms of taste, (Treatment A) with the mean score of 8.23 was "Liked Extremely". (Treatment B)) with the mean score of 7.99, and (Treatment C) with the mean score of 7.95 were "Liked Very Much". Moreover, in terms of texture, (Treatment A) was interpreted as "Liked Extremely" with the mean score of 8.24, (Treatment B) with the mean score of 8.04, and (Treatment C) with the mean score of 7.95 were "Liked Very Much". Furthermore, the consumers of the product have generally preferred (Treatment A) with the mean score of 8.23, interpreted as "Liked Extremely," while (Treatment B) got the mean score of 7.99 and (Treatment C) with the mean score of 8.23, interpreted as "Liked Extremely," while (Treatment B) got the mean score of 7.99 and (Treatment C) with the mean score of 8.23, interpreted as "Liked Extremely," while (Treatment B) got the mean score of 7.99 and (Treatment C) with the mean of 7.95, interpreted as "Liked Very Much".

The result implies that the addition of novel ingredients to traditional bread recipes, such as squash gourd and sweet potato leaves, introduced the need for sensory evaluation to ensure consumer acceptability. The sensory properties of bread, play a crucial role in shaping consumer perceptions and acceptance.

The result supported El-Badry et al's. (2021) assertion that the introduction of vegetable ingredients into bread formulations impacts its sensory attributes, especially in terms of texture and taste. The success of incorporating these ingredients hinges on maintaining a balance between their nutritional advantages and consumer preferences. Similarly, a study by Song et al. (2023) found that although consumers were initially hesitant toward bread enriched with vegetables, after tasting and evaluating the products, many found the new formulations pleasant, especially when vegetables were included in moderate amounts. This highlighted the importance of understanding the optimal proportions for each ingredient to maximize both the nutritional and sensory appeal of the bread. According to Olayemi et al. (2022), consumer acceptance of bread made with sweet potato flour was influenced by the balance between the functional benefits of the vegetable and the familiar taste of traditional bread. When introducing new ingredients, it is important to maintain the bread's overall appeal by keeping the sensory attributes within acceptable ranges. This is especially true when using vegetables like squash gourd, which may impart a distinctive taste and texture to the bread.



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Table 4. General acceptability of pandesal with squash and sweet potato leaves in terms of sensory qualities.

| | | | | Treatments | | |
|-----------------------|------|-----|------|------------|------|--------|
| Α | | | | В | C | ļ , |
| Sensory Qualities | Mean | QD | Mean | QD | Mean | QD |
| Appearance | 8.40 | LE | 8.15 | LE | 8.10 | LVM |
| Aroma | 8.05 | LVM | 7.93 | LVM | 7.81 | LVM |
| Taste | 8.23 | LE | 7.99 | LVM | 7.95 | LVM |
| Texture | 8.24 | LE | 8.04 | LVM | 7.95 | LVM |
| General Acceptability | 8.23 | LE | 8.03 | LVM | 7.95 | LVM |

Quality Description

Legend: LE- Liked Extremely

LVM – Liked Very Much LM- Liked Moderately

LS- Liked Slightly

NLD- Neither Like or Disliked DS- Disliked Slightly DM- Disliked Moderately DE- Disliked Extremely

Difference in the Sensory Qualities of Pandesal with Squash and Sweet Potato Leaves in Three Treatments

Table 5 presents difference in the sensory qualities of pandesal with squash and sweet potato leaves in three treatments in terms of appearance, aroma, color, taste, and texture. The result revealed that there was no significant difference in the appearance, aroma, taste and texture of the three treatments as rated by semi-trained panelists (z-value= .0957, p-value=0.620>.01), (z-value= 4.797, p-value=0.091>.01), (z-value= 2.936, p-value=0.230>.01), (z-value= 1.487, p-value=0.476>.01). Therefore, this failed to reject the null hypothesis of the study stating that there is no significant difference exists in the appearance, aroma, taste, and texture of the three treatments of mashed squash gourd and powdered sweet potato leaves in making pandesal. This implies that the product's appearance, aroma, taste, and texture remained the same due to the variation in the amount of mashed squash gourd and powdered sweet potato leaves in making pandesal.

The result supported Nwachukwu et al. (2021), who investigated the incorporation of squash flour into bread, noting that squash enhanced the bread's moisture retention, texture, and overall acceptability, with consumer panelists rating the aroma and flavor favorably. Their findings supported the idea that gourd-based ingredients can provide valuable sensory improvements without negatively affecting consumer preference. Additionally, sweet potato leaves, known for their rich content of vitamins and minerals, have been explored in bakery formulations to increase fiber and antioxidant content. Rojas et al. (2020) found that sweet potato leaves, when dried and powdered, could be successfully incorporated into baked goods, resulting in a product that maintained good sensory quality while offering significant nutritional benefits. According to Kadam et al. (2021), the sensory attributes of modified breads, noting that the incorporation of these ingredients can affect appearance, texture, taste, and aroma, with consumer acceptability varying based on the formulation.

| Table 5. Difference in the sensory qualities of pandesal with squash and sweet potato leaves in three treatments in term |
|--|
| of appearance, aroma, color, taste, and texture. |

| Sensory Qualities | z-value | p-value | Remarks |
|-------------------|---------|---------|---------|
| Appearance | 0.957 | 0.620 | ns |
| Aroma | 4.797 | 0.091 | ns |
| Taste | 2.936 | 0.230 | ns |
| Texture | 1.487 | 0.476 | ns |

p-value > .01 alpha

Difference in the Acceptability of Pandesal with Squash and Sweet Potato Leaves

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Table 6 presents the difference in the acceptability of pandesal with squash and sweet potato leaves in terms of sensory qualities among three treatments. The result showed no significant difference on the consumers' acceptability on the appearance of the three products (Treatments A, B, and C) with F-ratio=3.696, p-value=.026>.01. This result implies that consumers have different tastes when it comes to the appearance of pandesal made with mashed squash gourd and powdered sweet potato leaves. In terms of aroma, consumers' acceptability of the three products (Treatments A, B, and C) did not significantly differ (F-ratio=1.482, p-value=.229>.01). Moreover, consumers' acceptability of the taste of the product did not significantly differ as indicated by the result (F-ratio=2.201, p-value=.112>.01). This implies that consumers' acceptability of the product was similar to different bread products being produced using mashed squash gourd and powdered sweet potato leaves in making pandesal. However, the consumers' acceptability in terms of texture of the product significantly differed as shown by the result (F-ratio=1.978, p-value=.140>.01). This implies that the product (Treatments A, B, and C) had obtained a good texture as pandesal. Thus, this failed to reject the null hypothesis that consumers' acceptability of the aroma of the product differes.

The result of the study supported the claim of Akinmoladun et al. (2018), who incorporated sweet potato flour in different quantities into bread and found that while higher concentrations of sweet potato flour improved nutritional content, it also required careful balancing to ensure acceptable taste and texture. Their study highlighted the importance of optimizing ingredient levels to maintain the sensory appeal of the product. Similarly, Tiwari et al. (2021) evaluated the impact of adding squash flour to bread formulations, reporting that the inclusion of squash improved both the bread's moisture retention and overall texture, making it more acceptable to consumers. The sensory evaluation results indicated that squash-enriched bread was well received, with improved acceptability scores for aroma and taste. Additionally, the result also supported the study by Ibrahim et al. (2021). They investigated the effects of incorporating different vegetables, including pumpkin and squash, into bread dough. The study focused on the sensory evaluation (appearance, aroma, taste, texture) and nutritional improvement, particularly the increase in vitamins and minerals such as Vitamin A and potassium. Their findings suggested that incorporating vegetables in small to moderate amounts (10-15%) does not negatively affect the sensory characteristics of the bread and enhances its nutritional value.

Moreover, Kivaisi et al. (2022) examined the effects of incorporating sweet potato leaves into bread. Their sensory evaluations, conducted using both trained and semi-trained panels, focused on color, texture, aroma, taste, and appearance. The study found that up to 15% incorporation of sweet potato leaves in the dough did not compromise the bread's acceptability, supporting the idea of incorporating vegetable-based ingredients in bread-making while maintaining desirable sensory characteristics. Similarly, the study by Adejumo and Ojo (2020) revealed improved appearance and color, while sensory characteristics like taste and texture were found to vary depending on the amount of vegetable ingredient used.

| Sensory Qualities | Sum Squares | of df | Mean Square | F | Sig. | Remarks |
|-------------------|----------------|-------|----------------|-------|------|---------|
| | 5.219 | 2 | 2.609 | 3.696 | .026 | ns |
| Appearance | 207.556 | 294 | .706 | | | |
| | 212.774 | 296 | | | | |
| | 2.909 | 2 | 1.455 | 1.482 | .229 | ns |
| Aroma | 288.606 | 294 | .982 | | | |
| | 291.515 | 296 | | | | |
| | 4.633 | 2 | 2.316 | 2.201 | .112 | ns |
| Taste | 309.394 | 294 | 1.052 | | | |
| | 314.027 | 296 | | | | |
| | 4.451 | 2 | 2.226 | 1.978 | .140 | ns |
| Texture | 330.768 | 294 | 1.125 | | | |
| | 335.219 | 296 | | | | |

Table 6. Difference in the acceptability of pandesal with squash and sweet potato leaves in terms of sensory qualities among three treatments.

p-value > .01 alpha, not significant, *p*-value<.01, significant

Shelf Life of the Three Products at Room and Chilling Temperature



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Table 7 presents the observed shelf life of the pandesal (Treatments A, B, and C) sealed in a container when stored at room from water and sunlight. The observation of the shelf life was done every day to examine if the product was of good quality or if there were any changes taking place.

The result showed that the pandesal (Treatments A, B, and C) stayed only for three (3) days at room temperature for all treatments. However, on the 4th day, the product (in all treatments) was noticed to have changes like mold formation and staleness. The result reinforced the idea that temperature plays a crucial role in the shelf life of pandesal. At room temperature, all treatments showed signs of mold formation and staleness by the fourth day, suggesting that external conditions were not optimal for longer preservation. This implies that controlling temperature, such as storing at a lower, chilled environment, can significantly slow down spoilage.

| Variant | One Day Mold Formation | Three Days Mold Formation | Four Days Onwards Formation | Molds |
|-------------------------|----------------------------------|-------------------------------------|--------------------------------|-------|
| Treatment A | - | - | + | |
| (95g squash + 5g | | | + | |
| sweet potato | - | - | | |
| leaves) | | | | |
| | | | + | |
| | _ | _ | | |
| Treatment B | | | + | |
| (90g squash + 10g) | _ | _ | + | |
| sweet potato | _ | _ | + | |
| leaves) | - | _ | | |
| | | | + | |
| | - | _ | + | |
| Treatment C | - | _ | + | |
| (85g squash + 15g) | - | _ | | |
| sweet potato leaves) | | | | |

| Shelf life of | pandesal | at room | tem | perature |
|---------------|----------|---------|-----|----------|
| billen me or | pundebui | ut 100m | tom | perature |

Legend: Negative (-) no molds formation; Positive (+) molds formation observed

Microbial Analysis of Pandesal with Squash and Sweet Potato Leaves

Table shows the report of microbial analysis of pandesal with squash and sweet potato leaves samples conducted by the Department of Science and Technology (DOST) Regional Office, with TSR No. R6-032025-MIC-0182-0271, submitted on March 17, 2025, analyzed on March 17-26, 2025, and reported on March 28, 2025, as attached in Appendix J. The pandesal with squash and sweet potato leaves with 250 grams in total were subjected to Aerobic Plate Count, Salmonella, and Yeasts and Molds Count.

The presented result indicated that the pandesal with squash and sweet potato leaves had Aerobic Plate Count of <250 CFU/g sample. Salmonella spp. was not detected in 25g sample, with mold and yeast count of 630 CFU/g.

The microbial analysis method was employed for pandesal with squash and sweet potato leaves to ensure the safety and quality of product. The assessment involved the use of conventional microbiological methods to determine factors, such as the overall number of bacteria, yeast, mold, and specific disease-causing microorganisms.

The result implies that the validation procedure included assessments of precision, accuracy, specificity, and the robustness of the method. The study's findings provided a substantial contribution to improving food safety measures in the making of pandesal.

The result supported Patil et al. (2022), who examined microbial and proximate analysis of breads enriched with sweet potato leaves and found a decrease in microbial growth compared to conventional bread. Furthermore, the proximate analysis revealed an increase in fiber, protein, and vitamin A content, which supports the functional benefits of incorporating these ingredients into bread. In a study by Zhang et al. (2022), it was found that pumpkin-based bread exhibited lower levels of spoilage microorganisms, likely due to the natural preservatives present in the squash gourd.



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Similarly, sweet potato leaves have been noted for their antimicrobial properties, particularly against common spoilage microorganisms like molds and yeast (Le et al., 2021). A study by Li et al. (2022) investigated the effects of vegetable addition on the microbial safety of bakery products, specifically focusing on sweet potato and pumpkin. The study found that the addition of vegetables had minimal impact on microbial contamination when proper food safety measures were implemented. The researchers noted that antioxidant-rich vegetables, like sweet potato leaves, may have a natural preservative effect, which aligned with the microbial and storage stability analysis of the study.

A study by Razak et al. (2021) suggest that sweet potato leaf powder helps preserve the bread's quality by minimizing spoilage and maintaining flavor over time. Therefore, evaluating both the pre- and post-baking shelf life of the product will be essential to determine its commercial viability.

| Table 8. Microbial analysis of pandesal with squash and sweet potato leaves. | | | | | |
|--|----------------------|----------------------------------|--|--|--|
| Sample Description | Parameter | Result | | | |
| Pandesal with Squash and Sweet Potato Leaves -250g | Aerobic Plate Count | <250 CFU/g sample (estimated) | | | |
| | Salmonella | Not Detected in 25g sample | | | |
| | Mold and Yeast Count | 630 CFU/g sample | | | |

Proximate Analysis of Pandesal with Squash and Sweet Potato Leaves

Table 9 shows the report of proximate analysis of pandesal with squash and sweet potato leaves samples conducted by the Negros Prawn Producers Cooperative Analytical and Diagnostic Laboratory in Bacolod City, which was submitted on April 22, 2025, and reported on April 20, 2025, as attached in Appendix K.

The pandesal with squash and sweet potato leaves with 250g sample was subjected to fat, carbohydrates, moisture, protein, and calories., for fat by Soxhlet Extraction Method, carbohydrates by Phenol Sulfuric Acid Method, moisture by Gravimetric Oven Drying at 105°C, protein Kjeldahl Method, and calories 58-33g.

As shown in the result, the pandesal had fat of 9.0, carbohydrates of 61.4, moisture of 21.4 grams, protein of 7.8, and calories 125.

The results given in the report were those obtained at the time of examination and referred only to the particular sample submitted.

The result implies that the growing awareness of plant-based remedies also positions pandesal with squash and sweet potato leaves as a sustainable, natural option for enhancing the health benefits of the product. This could open doors for further research and development of health-promoting bread variants.

The result aligned with that of Rojas et al.'s (2020), confirming that adding plant-based powders can significantly alter the nutritional composition of baked goods, improving their content of fiber, vitamins, and antioxidants. According to Eze et al. (2021), the proximate analysis of vegetable-enriched breads often reveals higher protein, fiber, and micronutrient content, which could contribute to the bread's functional properties. A study by Balogun et al. (2021) investigated the nutritional composition of bread enriched with sweet potato and squash gourd powder, finding significant increases in fiber, vitamin A, and antioxidants.



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Table 9. Proximate analysis of pandesal with squash and sweet potato leaves.

| Sample Description | Parameter | Result/250g |
|--------------------|---------------|-------------|
| | Fat | 9.0 |
| | Carbohydrates | 61.4 |
| Pandesal | Moisture | 21.4 |
| | Protein | 7.8 |
| | Calories | 125 |

IV. CONCLUSION

Based on the findings of the study, the following conclusions were drawn. Using mashed squash and powdered sweet potato leaves in pandesal is a creative and healthy twist on traditional breadmaking.

The ingredients are effective when incorporated to local and natural food sources into bakery products, supporting sustainability and encouraging healthier eating habits.

The three treatments formulated are extremely appealing in terms of appearance, extremely pleasant in terms of aroma, very much delicious and extremely soft in terms of sensory qualities.

The mashed squash and powdered sweet potato leaves in pandesal is acceptable considering its sensory qualities. The use of mashed squash gourd and powdered sweet potato leaves as ingredients in making pandesal does not

significantly affect its sensory qualities, suggesting that both ingredients can be incorporated into bread-making without compromising consumer acceptance.

Both mashed squash and powdered sweet potato leaves can be used in making pandesal without affecting consumer acceptability in terms of sensory qualities. These ingredients can be viable options for enhancing the nutritional value of pandesal while maintaining its characteristics.

The shelf life of pandesal remains stable across all treatments when stored properly. Whether stored at room temperature for up to three days or at chilling temperature for up to seven days, the sensory attributes remain unchanged, ensuring consistent quality. The use of airtight containers and proper sealing plays a crucial role in maintaining freshness.

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