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Acceptability of Leaf-Enriched Buns Using Kangkong (*Ipomoea Aquatica*), and Kulitis (*Amaranthus Viridis*) Leaves as Functional Ingredients for Calamity Situations

Frezza B. Palattao

Isabela State University-City of Ilagan Campus, 3300 Philippines

ABSTRACT: This study developed and evaluated leaf-enriched buns using powdered Kangkong (*Ipomoea aquatica*) and Kulitis (*Amaranthus viridis*) leaves as functional ingredients, aiming to provide a nutritious and practical food option during calamities. Three bun formulations with varying leaf powder levels (20 g, 30 g, and 50 g) were prepared and assessed by 50 respondents using a 5-point hedonic scale to measure taste, texture, aroma, color, and overall acceptability. Results indicated that the 30 g formulation (T2) was the most preferred, achieving the highest mean scores across all attributes, while the 50 g formulation (T3) received lower ratings due to stronger vegetal notes. The incorporation of Kangkong and Kulitis powders enhanced the buns' nutritional profile by providing essential vitamins, minerals, and energy, while the product remained convenient, ready-to-eat, and easy to store. These findings demonstrate that leaf-enriched buns are a viable, sustainable, and health-supporting alternative to conventional relief foods, promoting food resilience and improved nutrition in emergency situations.

KEYWORDS: Leaf-enriched buns, Kangkong (Ipomoea aquatica), Kulitis (Amaranthus viridis), functional ingredients, calamity food, nutritional enhancement, food fortification

I. INTRODUCTION

Natural calamities such as typhoons, floods, and earthquakes often disrupt food supply chains in the Philippines. During these emergencies, families struggle to access nutritious, ready-to-eat food. Relief goods are usually non-perishable but often lack essential nutrients, which can negatively affect the health of vulnerable populations.

To address this problem, there is a need to develop functional foods that are nutritious, affordable, and shelf stable. Leafy vegetables like kangkong (*Ipomoea aquatica*) and kulitis (*Amaranthus viridis*) are widely available in the Philippines, grow quickly, and are rich in vitamins, minerals, and antioxidants. Converting these leaves into powder extends their shelf life and allows easy incorporation into staple foods such as bread.

Several studies support the use of these vegetables for food enrichment. Joshi et al. (2021) found that water spinach powder retains protein, fiber, and antioxidant compounds, making it a suitable functional ingredient. Sarker and Oba (2020) reported that amaranth leaves are rich in calcium, iron, and phenolic compounds, which provide nutritional and antioxidant benefits. Furthermore, Oyinloye et al. (2023) demonstrated that adding amaranth leaf powder to wheat bread improved its mineral content and functional quality, although excessive amounts can slightly affect taste.

By incorporating these nutrient-dense leaves into bread, this study aims to develop an innovative functional product that promotes food resilience and nutritional sufficiency during emergencies. The product offers a locally sourced, affordable, and health-supporting alternative to conventional relief goods, contributing to improved community nutrition and more sustainable food systems during calamities.

This study aims to:

1. Develop a leaf-enriched bread using powdered Kangkong (*Ipomoea aquatica*) and Kulitis (*Amaranthus viridis*) leaves as functional ingredients.
2. Assess the sensory acceptability of the bread in terms of taste, texture, aroma, color, and overall preference.
3. Evaluate the potential of the bread as a nutritious and practical food option during calamities.

II. METHODOLOGY

This study employed a descriptive–developmental research design to develop leaf-enriched buns using powdered Kangkong (*Ipomoea aquatica*) and Kulitis (*Amaranthus viridis*) leaves and to evaluate their sensory acceptability. The developmental aspect

involved creating three bun formulations with varying amounts of leaf powder, while the descriptive aspect focused on assessing their sensory qualities through evaluation by selected respondents.

Three treatments were prepared by varying the amount of combined Kangkong and Kulitis powder, while all other ingredients remained constant:

- Treatment 1 (Low Level): 20 g of combined Kangkong and Kulitis powder
- Treatment 2 (Moderate Level): 30 g of combined Kangkong and Kulitis powder
- Treatment 3 (High Level): 50 g of combined Kangkong and Kulitis powder

These variations were designed to determine the effect of increasing leaf powder levels on the buns' appearance, aroma, taste, texture, and overall acceptability.

2.1 Sensory Evaluation

A total of 50 respondents, including 20 TESDA trainers and 30 randomly selected participants, evaluated the three treatments using a 5-point Likert scale (1-Not Acceptable, 5-Highly Acceptable). The sensory attributes assessed included taste, texture, aroma, color, and overall acceptability. The formulation with the highest mean score across attributes was identified as the most acceptable.

Table 1. Sensory Evaluation Rating Scale

Scale	Mean	Descriptive Interpretation
5	4.50 - 5.00	Highly Acceptable
4	3.50 - 4.49	Acceptable
3	2.50 - 3.39	Moderately Acceptable
2	1.50 - 2.49	Slightly Acceptable
1	1.00 - 1.49	Not Acceptable

2.2. Instrument and Materials

The following tools and equipment were used in preparing the leaf-enriched buns.

Table 2. Tools and Equipment

Equipment	Use / Function
Oven	Bakes the dough to produce finished buns
Stand mixer	Use for kneading the dough
Weighing scale	Measures ingredients accurately
Measuring cups and spoons	Ensures standardized ingredient measurements
Mixing bowls	Used to mix ingredients and prepare dough
Baking Sheet	Holds dough during baking
Cooling rack	Allow baked buns to cool properly
Food processor / blender	Grinds dried leaves into fine powder
Dough cutter	Used for scraping and cutting dough
Knife and chopping board	Trims and cuts fresh leaves prior to drying
Stainless strainer / colander	Used for washing and draining fresh leaves

Table 3. Ingredient Formulations for each Treatment

Ingredients	Treatment 1	Treatment 2	Treatment 3
Kangkong and kulitis Powder	20g	30g	50g
Bread Flour	250g	250g	250g
Skimmed Milk	10g	10g	10g
Yeast	3g	3g	3g
Sugar	40g	40g	40g
Salt	3g	3g	3g
Water	100g	100g	100g
Egg	1pc	1pc	1pc
Shortening	25g	25g	25g

2.3. Procedure

The researcher followed a series of steps in preparing and baking the Leaf-Enriched Buns using Kangkong (*Ipomoea aquatica*) and Kulitis (*Amaranthus viridis*) leaf powders.

A. Drying and Powdering Process

Get the fresh tender leaves of kangkong and kulitis leaves. Pluck the leaves, discard the stems and stalk, and thoroughly wash them twice or thrice in water. Pat dry carefully with a towel or air-dry until no surface moisture remains. Put the clean leaves on the cookie sheets, then dry at 70°C until adequately dried. When they are crisp, carefully crush them, remove any remaining stems and stalks, and then powder the leaves in a mixer before storing them in an airtight jar. (Oric et al. 2023).

Figure 1. Drying process

Figure 2. Powdered leaves

B. Baking Process

- Perform *mise en place* by preparing and measuring all ingredients and tools.
- Preheat the oven to **180°C** for **10 minutes.**
- In a mixing bowl, combine all dry ingredients.
- Create a well at the center and pour in the liquid ingredients.
- Mix and knead the dough until it becomes smooth and elastic.
- Brush the sides of the bowl with oil. Form the dough into a ball, place it back in the bowl, cover with plastic wrap, and let it rise in a warm area for **1 hour** or until doubled in size. Remove the plastic wrap and punch down the dough to release excess gas.
- Cut and portion the dough into your preferred bun sizes.
- Shape each portion into buns, arrange them on a baking sheet, and proof again for **1 hour** or until doubled in size.
- Bake in the preheated oven at **180°C** for **15–20 minutes**, or until the tops turn light brown.
- Allow the buns to cool completely before placing them in plastic packaging.

2.4. Data Analysis

Descriptive statistics, including the mean and standard deviation, were calculated to summarize the respondents' ratings for each sensory attribute, such as appearance, aroma, taste, texture, and overall acceptability. To determine whether there were significant differences among the three treatments, a One-Way Analysis of Variance (ANOVA) was performed. This allowed the researcher to identify whether the varying levels of Kangkong and Kulitis leaf powder had a statistically significant effect on the sensory qualities of the buns.

III. RESULTS AND DISCUSSION

3.1. Development of a leaf-enriched bread using powdered Kangkong (Ipomoea aquatica) and Kulitis (Amaranthus viridis) leaves as functional ingredients

The study successfully developed leaf-enriched buns by incorporating powdered Kangkong (*Ipomoea aquatica*) and Kulitis (*Amaranthus viridis*) leaves into the bread formulation. Three treatments were prepared with varying levels of combined leaf powder—20 g, 30 g, and 50 g—while keeping all other ingredients constant. The buns were properly mixed, kneaded, proofed, and baked, resulting in well-formed products with uniform texture and shape. The drying and powdering process of the leaves produced fine powders that were easily incorporated into the dough, ensuring even distribution throughout each bun. The buns retained a slightly green hue, indicating the presence of the leafy ingredients, and had acceptable structural integrity, making them suitable as a functional food product. Overall, the development process demonstrated that Kangkong and Kulitis powders can be effectively used as functional ingredients in bread, providing both nutritional enhancement and visual appeal.

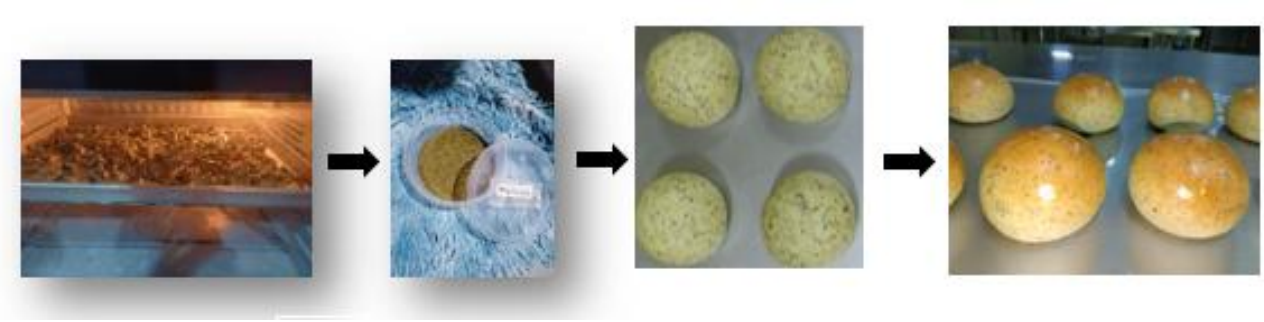

Figure 1. Sample Product Development

3.2. Sensory acceptability of the bread

The sensory evaluation results show a clear preference for the buns prepared with 30 g of leaf powder (T2), which consistently achieved the highest mean scores across all attributes. T2 was rated *highly acceptable* in taste (M = 4.85), texture (M = 4.77), aroma (M = 4.65), and color (M = 4.60), reflecting a well-balanced formulation that retained desirable sensory qualities while incorporating the powdered Kangkong and Kulitis leaves. In contrast, T1 (20 g) received *acceptable* ratings across all attributes, indicating that the lower amount of leaf powder produced a product that was generally liked but lacked the enhanced appeal observed in T2. Meanwhile, T3 (50 g) consistently yielded the lowest scores, particularly in aroma (M = 3.55) and taste (M = 3.70), suggesting that the higher concentration of leaf powder may have resulted in stronger vegetal notes and less favorable visual and textural characteristics. The overall acceptability ratings reinforce these findings, with T2 obtaining the highest mean (M = 4.72), compared to T1 (M = 4.12) and T3 (M = 3.67). Based on these results, T2 emerges as the most preferred formulation, offering the optimal combination of sensory qualities among the three treatments.

Table 4. Sensory Evaluation Scores of Leaf-Enriched Buns

Sensory Attribute	**T1 (20 g)**	**T2 (30 g)**	**T3 (50 g)**	**Interpretation**
Taste	4.16	4.85	3.70	T1 – Acceptable T2 – Highly Acceptable T3 – Acceptable
Texture	4.00	4.77	3.78	T1 – Acceptable T2 – Highly Acceptable T3 – Acceptable
Aroma	4.20	4.65	3.55	T1 – Acceptable T2 – Highly Acceptable T3 – Acceptable
Color	4.12	4.60	3.63	T1 – Acceptable T2 – Highly Acceptable T3 – Acceptable
Overall Acceptability	**4.12**	**4.72**	**3.67**	T1 – Acceptable **T2 – Highly Acceptable** T3 – Acceptable

3.3. Evaluation of the Bread as a Nutritious and Practical Food Option During Calamities

The leaf-enriched bread made with Kangkong (Ipomoea aquatica) and Kulitis (Amaranthus viridis) leaves was evaluated to see if it could be a good food option during calamities. Adding these leafy vegetables made the bread more nutritious than regular bread. It contains important vitamins and minerals like iron, calcium, and vitamin A, which are essential for keeping people healthy, especially during emergencies. The bread also provides energy through carbohydrates, making it a practical food for people who need quick nourishment. The bread is easy to store, transport, and eat without extra preparation. During calamities, when cooking may not be possible, this makes it a convenient food option. Sensory evaluation showed that participants liked the taste, texture, aroma, and overall appearance of the bread, meaning it is enjoyable to eat.

IV. CONCLUSION

Leaf-enriched buns made with Kangkong (Ipomoea aquatica) and Kulitis (Amaranthus viridis) powders were successfully developed, with the 30 g formulation (T2) being the most preferred for taste, texture, aroma, color, and overall acceptability. The buns provide added nutritional benefits, including essential vitamins and minerals, making them a practical, ready-to-eat, and

enjoyable food option during calamities. This study demonstrates that locally available leafy vegetables can be effectively used to enhance both the nutrition and appeal of staple foods, offering a sustainable and health-supporting alternative to conventional relief goods in emergency situations.

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