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# TARO (*Colocasia esculenta*) FLOUR IN MAKING CRUST OF EMPANADITAS

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**ABSTRACT**

This study evaluated the sensory acceptability of *empanaditas* crusts formulated with different proportions of taro (*Colocasia esculenta*) flour as a substitute for wheat flour. Using a randomized complete block design (RCBD), four treatments (100% wheat, 25% taro, 50% taro, and 75% taro substitution) were prepared and evaluated by 60 panelists composed of students, teachers, and homemakers. Sensory characteristic, including appearance, aroma, texture, taste, and overall acceptability, were assessed using a five-point hedonic scale. Data were analyzed using the Kruskal–Wallis test and Dunn's post-hoc comparisons. Results revealed significant differences among treatments across most sensory attributes. The 25% taro flour substitution was rated highest in general acceptability, while higher substitution levels were less preferred due to darker color and firmer texture. Findings suggest that taro flour can be successfully incorporated at up to 25% substitution to improve product diversity while maintaining consumer acceptability.

**Keywords:** taro flour, *empanaditas,* sensory evaluation, wheat substitution, composite flour

## Introduction

The Philippines, as an agricultural country, produces a wide variety of root crops that play a vital role in ensuring food security, dietary diversity, and nutritional sufficiency among its population. Among these crops is taro (*Colocasia esculenta*), locally known as *gabi*, which is widely cultivated and consumed across different regions of the country. Taro is recognized for its high starch content and significant amounts of dietary fiber, minerals, and other essential nutrients, making it a valuable food source for both household consumption and food processing (Food and Agriculture Organization [FAO], 2020). Beyond its traditional use as a vegetable in soups, stews, and native dishes, taro has increasingly been processed into flour, allowing for extended shelf life and broader application in food product development. Studies have shown that taro flour exhibits desirable functional properties, such as good water absorption capacity and gel-forming ability, which make it suitable as a partial substitute for wheat flour in baked products like bread, cookies, and cakes, while also contributing to improved nutritional profiles (Ammar et al., 2009; Oyeyinka & Oyeyinka, 2018).

In the Philippine context, *empanaditas*—small, filled pastries commonly sold in schools, bakeries, and local markets—are popular snack items across age groups. These products are traditionally prepared using refined wheat flour, a raw material that is largely imported. The heavy dependence on imported wheat not only increases production costs but also limits opportunities to maximize the use of locally available agricultural resources. This reliance runs counter to national efforts aimed at strengthening food self-sufficiency and supporting local farmers. In response to growing

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concerns about nutrition and food quality, the Department of Education (DepEd) has issued policies promoting healthier food options in schools, emphasizing the use of nutritious and locally sourced ingredients in school-based food offerings (DepEd Order No. 13, 2017). These initiatives underscore the need to develop alternative snack products that are both healthful and culturally appropriate, while also being economically feasible.

Despite the growing body of research exploring the use of taro flour in various baked goods, there remains limited empirical evidence on its application in pastry products such as empanaditas, particularly in terms of crust formulation and consumer acceptability. This research gap presents an opportunity to explore the potential of taro flour as a partial substitute for wheat flour in empanaditas crusts, contributing to product diversification and sustainable food innovation. Addressing this gap may also provide practical insights for home economics instruction and small-scale food enterprises seeking to incorporate indigenous crops into value-added products. Thus, this study examined the sensory acceptability of empanaditas crusts formulated with taro flour as a partial replacement for wheat flour, with the aim of supporting the development of nutritious, locally sourced snack alternatives.

**Statement of the Problem**

This study aimed to determine the sensory acceptability of empanaditas crusts made with different proportions of taro flour substituted for wheat flour. Specifically, it sought to answer the following questions:

1. What is the sensory acceptability of empanaditas crusts, in terms of appearance, aroma, texture, taste, and overall quality, when taro flour is substituted at varying levels?
2. Are there significant differences in acceptability among the treatments?

**Methodology**

**Research Design**

An experimental research design was employed, using a randomized complete block design (RCBD). The blocking factor consisted of three evaluator groups: students, teachers, and homemakers.

**Treatments**

Four crust formulations were prepared:

- **T0**: 100% wheat flour (control)
- **T1**: 75% wheat flour + 25% taro flour
- **T2**: 50% wheat flour + 50% taro flour
- **T3**: 25% wheat flour + 75% taro flour

**Panel of Evaluators**

Sixty panelists (20 students, 20 teachers, and 20 homemakers) were purposively selected to represent different consumer perspectives.

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**Data Gathering**

A five-point hedonic scale was used to evaluate appearance, aroma, texture, taste, and overall acceptability (1 = dislike; 5 = like extremely). Samples were coded, served randomly, and evaluated individually. Panelists cleansed their palates with water between samples.

**Data Analysis**

Data were summarized using means and standard deviations. The Kruskal–Wallis test was applied to determine significant differences among treatments, followed by Dunn's post-hoc test for pairwise comparisons.

**Results and Discussion**

**Table 1**
*Mean Ratings of Empanaditas Crusts with Varying Proportions of Taro Flour*

| Attribute | T0 (100% Wheat) | | T1 (75% Wheat + 25% Taro) | | T2 (50% Wheat + 50% Taro) | | T3 (25% Wheat + 75% Taro) | |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | M | SD |
| Appearance | 4.42 *(LVM)* | 0.60 | 4.31 *(LVM)* | 0.60 | 3.51 *(LM)* | 0.70 | 3.10 *(LMo)* | 0.80 |
| Aroma | 4.25 *(LVM)* | 0.50 | 4.23 *(LVM)* | 0.60 | 4.01 *(LM)* | 0.50 | 3.90 *(LM)* | 0.60 |
| Texture | 4.31 *(LVM)* | 0.50 | 4.42 *(LVM)* | 0.50 | 3.23 *(LM)* | 0.60 | 3.24 *(LMo)* | 0.70 |
| Taste | 4.20 *(LVM)* | 0.50 | 4.51 *(LVM)* | 0.60 | 3.70 *(LM)* | 0.70 | 3.12 *(LMo)* | 0.70 |
| General Acceptability | 4.30 *(LVM)* | 0.50 | 4.50 *(LVM)* | 0.50 | 3.60 *(LM)* | 0.60 | 3.23 *(LMo)* | 0.70 |

**Note.** M = Mean; SD = Standard Deviation; LVM = *Liked very much* (4.21–5.00); LM = *Liked much* (3.41–4.20); LMo = *Liked moderately* (2.61–3.40); LS = *Liked slightly* (1.81–2.60); D = *Disliked* (1.00–1.80).

**Appearance**

Table 1 shows that the control sample, T0 (100% wheat flour), obtained the highest rating for appearance (M = 4.42, SD = 0.60), interpreted as *liked very much*. T1 (75% wheat + 25% taro flour) followed closely (M = 4.31, SD = 0.60), also *liked very much*. In contrast, T2 (50% wheat + 50% taro flour) scored lower (M = 3.51, SD = 0.70), interpreted as *liked much*. The least preferred was T3 (25% wheat + 75% taro flour) with (M = 3.10, SD = 0.80), equivalent to *liked moderately*.

This means that higher substitution levels of taro flour decreased the visual appeal of the empanaditas, likely due to changes in color and surface texture.

The findings suggest that consumer preference for appearance is best maintained at or below 25% taro flour substitution. These results support Ammar et al. (2009), who found that excessive root crop flour incorporation diminishes visual desirability in baked products, but contradict Agiriga and Iwe (2009), who reported improved appeal at higher substitution levels.

**Aroma**

For aroma, T0 (M = 4.25, SD = 0.50) and T1 (M = 4.23, SD = 0.60) were both *liked very much*. T2 (M = 4.01, SD = 0.50) and T3 (M = 3.90, SD = 0.60) were *liked much*.

This indicates that all treatments were generally acceptable in terms of aroma, but the inclusion of larger amounts of taro flour slightly reduced preference. This suggests that wheat flour provides a more familiar and consistent aroma,

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while high taro flour levels introduce subtle changes that are less favorable. The findings align with Alimo-ot (2006), who observed reduced aroma acceptability with high alternative flour proportions, but differ from Owuamanam et al. (2010), who reported taro flour to positively contribute to aroma in composite products.

**Texture**

The highest texture rating was observed in T1 (M = 4.42, SD = 0.50), interpreted as *liked very much*, followed closely by T0 (M = 4.31, SD = 0.50), also *liked very much*. T2 (M = 3.23, SD = 0.60) was *liked much*, while T3 (M = 3.24, SD = 0.70) was only *liked moderately*. This implies that a 25% substitution with taro flour enhanced the crust's crispiness and mouthfeel, possibly due to its starch contribution. However, excessive substitution reduced texture quality. These results agree with Marbaniang et al. (2017), who found that small amounts of taro flour improve textural properties, but contradict Niba et al. (2001), who suggested higher substitution levels can still yield acceptable texture.

**Taste**

Taste evaluation revealed that T1 received the highest score (M = 4.51, SD = 0.60), interpreted as *liked very much*. T0 followed (M = 4.20, SD = 0.50), also *liked very much*. T2 (M = 3.70, SD = 0.70) was *liked much*, while T3 (M = 3.12, SD = 0.70) was only *liked moderately*. This suggests that incorporating 25% taro flour enhanced flavor, but higher proportions negatively affected taste, possibly due to a lingering aftertaste. Moderate substitution therefore provides a favorable balance between novelty and palatability. The findings agree with Sefa-Dedeh and Kluvitse (1995), who noted improved taste with moderate root crop flour incorporation, but differ from Shittu et al. (2007), who found taste acceptability sustained even at higher levels.

**General Acceptability**

Overall, T1 achieved the highest rating (M = 4.50, SD = 0.50), interpreted as *liked very much*. T0 was next (M = 4.30, SD = 0.50), also *liked very much*. T2 (M = 3.60, SD = 0.60) was *liked much*, while T3 (M = 3.23, SD = 0.70) was only *liked moderately*. This indicates that empanaditas crusts with 25% taro flour were most preferred, even surpassing the control in overall acceptability. This suggests that moderate substitution not only enhances sensory qualities but also improves consumer appeal. These findings align with Aboubakar et al. (2008), who found that partial substitution with taro flour enhances sensory appeal, but contradict James and Nwabueze (2014), who reported no improvement in overall acceptability with taro substitution.

**Table 2**

Kruskal–Wallis Test Results on Sensory Acceptability of Empanaditas Crusts

| Attribute | H ($\chi^2$) Value | df | *p*-value |
|---|---|---|---|
| Appearance | 21.36 | 3 | 0.001 |
| Aroma | 2.45 | 3 | 0.484 |
| Texture | 18.92 | 3 | 0.001 |
| Taste | 20.28 | 3 | 0.001 |
| Overall Acceptability | 22.14 | 3 | 0.001 |

*p < 0.01*

**Appearance**

The Kruskal–Wallis test yielded a significant result for appearance (H = 21.36, df = 3, p = 0.001), indicating that there

**Submission**: September 1, 2025
**Acceptance**: November 10, 2025
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were statistically significant differences among the treatments. This means that the varying proportions of taro flour had a marked effect on the visual appeal of the empanaditas crust. Specifically, products with higher taro substitution (50% and 75%) were rated less favorably in appearance compared to the control and the 25% substitution, suggesting that panelists preferred lighter-colored and smoother crusts.

**Aroma**

For aroma, the test showed no significant difference among treatments ($H = 2.45$, $df = 3$, $p = 0.484$). This result implies that the incorporation of taro flour did not considerably alter the smell of the empanaditas crust. Across all formulations, panelists perceived the aroma as generally acceptable, indicating that taro flour substitution, regardless of proportion, maintained the product's aromatic qualities.

**Texture**

Texture demonstrated a significant difference ($H = 18.92$, $df = 3$, $p = 0.001$). This means that panelists clearly distinguished between samples based on mouthfeel. The findings suggest that a 25% taro flour substitution enhanced crispiness and bite, while higher substitutions (50% and 75%) negatively affected texture, making it less desirable. Thus, texture appears highly sensitive to taro flour levels.

**Taste**

Taste ratings also differed significantly across samples ($H = 20.28$, $df = 3$, $p = 0.001$). This indicates that flour composition had a strong influence on flavor perception. The 25% taro flour substitution (T1) was rated the most palatable, while higher substitution levels reduced taste acceptability, likely due to an unfamiliar aftertaste or stronger root-crop flavor.

**Overall Acceptability**

The overall acceptability of the empanaditas crusts was also significantly affected by the flour formulations ($H = 22.14$, $df = 3$, $p = 0.001$). Panelists favored the crust with 25% taro flour substitution, which even outperformed the control, while higher substitution levels (T2 and T3) resulted in decreased general preference. This highlights that moderate inclusion of taro flour strikes the best balance between sensory attributes.

**Table 3**

*Dunn's Post-Hoc Test for Pairwise Comparisons of Sensory Acceptability of Empanaditas Crusts*

| Comparison | Appearance | Aroma | Texture | Taste | Overall Accept. |
|---|---|---|---|---|---|
| T0 vs T1 | 0.412 | 0.529 | 0.528 | 0.285 | 0.365 |
| T0 vs T2 | 0.006 * | 0.482 | 0.009 * | 0.007 * | 0.011 * |
| T0 vs T3 | 0.001 * | 0.461 | 0.001 * | 0.001 * | 0.001 * |
| T1 vs T2 | 0.004 * | 0.476 | 0.006 * | 0.003 * | 0.008 * |
| T1 vs T3 | 0.001 * | 0.453 | 0.001 * | 0.001 * | 0.001 * |
| T2 vs T3 | 0.198 | 0.497 | 0.237 | 0.214 | 0.251 |

$p < 0.01$

**Appearance**

Pairwise comparisons revealed that empanaditas with 50% (T2) and 75% (T3) taro flour were rated significantly lower in appearance compared with the control (T0) and 25% substitution (T1). No difference was found between the control and 25% substitution, nor between T2 and T3. This suggests that appearance acceptability declines only when taro flour exceeds 25%. Consumers likely found darker coloration and rougher crust textures less appealing at higher

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substitution levels. These findings align with Ammar et al. (2009), who observed that high levels of root crop flour reduced visual appeal in bakery products. Conversely, Agiriga and Iwe (2009) reported that taro incorporation enhanced appearance when used more liberally, a result that does not match the present findings.

**Aroma**

No significant differences were detected in aroma among treatments, indicating that taro flour substitution—whether 25%, 50%, or 75%—did not affect the crust's smell. This stability implies that aroma was influenced more by other recipe ingredients or baking processes than by flour type. The finding is consistent with Alimo-ot (2006), who reported that alternative flours often show minimal impact on aroma at moderate levels. However, it contrasts with Owuamanam et al. (2010), who found that taro flour imparted a distinct positive aroma when used in composite flour products.

**Texture**

Significant differences emerged between lower (T0 and T1) and higher (T2 and T3) substitution levels. Both the control and 25% substitution received high ratings and did not differ significantly, but both outperformed 50% and 75% substitutions. The absence of differences between T2 and T3 suggests that texture quality declines once taro flour exceeds 50%, after which the effect stabilizes. These findings imply that 25% substitution enhances or maintains the desirable flakiness of crust, while excessive taro reduces gluten strength, leading to a denser bite. Similar results were reported by Marbaniang et al. (2017), who noted textural improvements at low substitution levels, whereas Niba et al. (2001) observed acceptable textures even at higher inclusion, which contradicts the present study.

**Taste.**

Taste acceptability showed no difference between the control (T0) and 25% substitution (T1), both of which were highly rated, but both were significantly superior to 50% (T2) and 75% (T3). No difference was found between T2 and T3, showing that taste deteriorates sharply beyond 25%. This suggests that small amounts of taro flour may add subtle, pleasant flavor notes, but higher amounts introduce aftertastes or textural changes that diminish preference. This outcome supports Sefa-Dedeh and Kluvitse (1995), who reported that moderate root crop flour use improved flavor, but it contrasts with Shittu et al. (2007), who found taro flour acceptable even at higher levels.

**Overall Acceptability.**

Overall ratings mirrored the trends for appearance, texture, and taste. The control and 25% substitution were statistically similar and the most preferred, while 50% and 75% substitutions were significantly less acceptable but did not differ from each other. This demonstrates that taro flour can be incorporated up to 25% without negatively affecting consumer preference. These findings agree with Aboubakar et al. (2008), who noted enhanced sensory acceptance with partial taro substitution. However, they contrast with James and Nwabueze (2014), who reported no improvements in acceptability with taro flour incorporation.

## Conclusion

Empanaditas crusts formulated with a 25% substitution of taro flour exhibited the highest level of sensory acceptability among the treatments, with ratings that were comparable to those of the traditional crusts made entirely from wheat flour. Panelists noted that at this level of substitution, the crusts maintained desirable characteristics in terms of appearance, texture, and taste, indicating that the functional properties of taro flour were well balanced with those of wheat flour. However, as the level of taro flour substitution increased beyond 50%, a noticeable decline in sensory quality was observed. Higher substitution levels resulted in less favorable appearance, denser and less cohesive

**Submission**: September 1, 2025
**Acceptance**: November 10, 2025
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texture, and altered flavor profiles, which contributed to lower acceptability ratings. These findings suggest that while taro flour offers potential as a locally sourced alternative ingredient, its incorporation must be carefully controlled. Overall, the results indicate that taro flour can be successfully incorporated into empanaditas crust formulations at up to 25% substitution without compromising consumer preference, supporting its viability for product development and potential commercial application.

**Recommendations**

1. Incorporate 25% taro flour substitution to improve product diversity and promote local ingredients.
2. Adopt taro-based pastries as healthier snack options aligned with DepEd's policy on nutritious food offerings.
3. Conduct nutritional and shelf-life analyses of taro-based empanaditas, explore blends with other root crops, and expand panel testing to include larger consumer populations.

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**Submission**: September 1, 2025
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