

Article

Sensory Acceptability, Texture and Crispiness of Jackfruit (*Artocarpus Heterophyllus*) Seeds for Chicharon Production

Janneka Fae Marsan¹, Irene Damolo^{2*}, Windy Soquillo³, Aira Claire Taneo⁴, Marjorie Añero⁵, Vivian Arnaiz⁶

¹Cebu Technological University – Main Campus, Philippines; jannekacapuno21@gmail.com

²Cebu Technological University – Main Campus, Philippines; damoloirene23@gmail.com

³Cebu Technological University – Main Campus, Philippines; soquillowindy@gmail.com

⁴Cebu Technological University – Main Campus, Philippines; taneoaira@gmail.com

⁵Cebu Technological University – Main Campus, Philippines; Marjorie.anero@ctu.edu.ph

⁶Cebu Technological University – Main Campus, Philippines; arnaizvivian86@gmail.com

* Correspondence: irenedamolo23@gmail.com

Abstract: Jackfruit (*Artocarpus heterophyllus*) seeds are frequently discarded as agricultural waste despite their nutritional value, leaving a significant research gap in their potential application for developed snack products like chicharon. This study evaluated the sensory acceptability and textural properties of jackfruit seed-based chicharon as a sustainable, plant-based alternative to traditional high-fat pork chicharon. Using an experimental research design, three treatments (T1, T2, and T3) were formulated with varying seed proportions while keeping other ingredients constant. A total of thirty respondents, including food experts and Food Service Management students, assessed the samples using a nine-point hedonic scale. One-way Analysis of Variance (ANOVA) revealed significant differences among treatments in texture ($p=0.0039$), crispiness ($p=0.0002$), and appearance ($p=0.0053$), whereas flavor and aroma showed no significant variation ($p > 0.05$). Treatment 1 (75g seeds) achieved the highest sensory scores, specifically for crispiness ($M = 8.23$) and overall acceptability ($M = 8.39$), corresponding to a 'Like Extremely' rating. These findings demonstrate that jackfruit seeds can be effectively upcycled into a viable snack alternative that meets consumer preferences for texture while addressing health and sustainability goals.

Keywords: jackfruit seeds; chicharon; sensory acceptability; plant-based snack; food innovation

Citation: J. F. Marsan, I. Damolo, W. Soquillo, A. C. Taneo, M. Añero, and V. Arnaiz, "Sensory Acceptability, Texture and Crispiness of Jackfruit (*Artocarpus Heterophyllus*) Seeds for Chicharon Production", *TEFA*, vol. 3, no. 2, pp. 128–134, May 2026.

Received: 11-04-2026

Accepted: 03-05-2026

Published: 16-05-2026



Copyright: © 2026 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution-ShareAlike 4.0 International License (CC BY SA) license (<http://creativecommons.org/licenses/by-sa/4.0/>).

1. Introduction

Sustainable food innovation increasingly focuses on the valorization of agricultural by-products to meet the growing demand for functional and plant-based alternatives [1, 2]. While plant-based snacks have successfully replicated the textures of traditional meat products [5, 6], a significant opportunity remains in the redesign of culturally popular but high-fat snacks like chicharon. Traditional pork-based chicharon is characterized by high saturated fat and cholesterol levels, contributing to long-term cardiovascular risks [4, 15]. Consequently, identifying nutrient-dense, plant-based raw materials capable of mimicking the aerated, crispy matrix of deep-fried pork skin is a critical area of food research.

Jackfruit (*Artocarpus heterophyllus*) seeds represent a significantly underutilized resource, typically discarded as waste despite being rich in carbohydrates, protein, and minerals [2, 3, 19, 20]. Research has established the versatility of jackfruit seed flour in bakery applications due to its high starch content [12–14]. However, a distinct research gap exists regarding the use of jackfruit seeds as a direct structural substitute for animal-

based chicharon. While previous studies have focused on jackfruit seed flour as a supplementary ingredient in baked goods [12–14], there is a lack of empirical data on its performance as a primary base for deep-fried, "crackling" snack innovations.

This study presents a novel approach by upcycling jackfruit seeds into a plant-based chicharon alternative, specifically engineered to replicate the sensory profile of the traditional version. By evaluating the sensory acceptability and textural properties—including texture, crispiness, flavor, aroma, and appearance—this research provides the first systematic assessment of jackfruit seeds in a chicharon production context. These findings aim to bridge the gap between agricultural waste management and the development of health-oriented, commercially viable snack products.

2. Materials and Methods

2.1 Research Design

This study employed an experimental research design following a Completely Randomized Design (CRD) to evaluate the sensory acceptability and textural properties of jackfruit (*Artocarpus heterophyllus*) seed-based chicharon. Three treatments (T1, T2, and T3) were formulated with varying proportions of jackfruit seeds, while the amounts of rice flour, water, and seasonings were kept constant. This design enabled the comparison of different formulations in terms of texture, crispiness, flavor, aroma, appearance, and overall acceptability.

2.2 Materials and Sample Preparation

The primary raw material consisted of jackfruit seeds sourced from local markets in Cebu City, Philippines. Additional ingredients included rice flour, salt, black pepper, garlic powder, turmeric, and water. Vegetable oil was utilized for the deep-frying process to ensure consistent heat distribution and stability. To ensure batch consistency and reliability, the preparation process was replicated three times under controlled conditions.

The base formulation consisted of 75 g of boiled, peeled, and mashed jackfruit seeds, 225 mL of water, 120 g of rice flour, 6 g of salt, 0.5 g of black pepper, 0.6 g of garlic powder, and 0.4 g of turmeric. Approximately 500 mL of cooking oil was used for deep-frying.

The preparation process involved washing and boiling the jackfruit seeds for 20–30 minutes until tender, followed by peeling to remove the outer seed coat. The peeled seeds were mashed and blended until a smooth consistency was achieved. The measured ingredients were added and mixed thoroughly until a uniform mixture was formed. The mixture was poured into molds, steamed for 10–15 minutes, cooled, and cut into uniform pieces. The samples were dried using a food dehydrator until the desired level of dryness was achieved, as dehydration plays a critical role in improving texture and shelf life of fried snack products [8]. Preliminary trials also explored oven-drying (170 °C for 20 minutes) and sun-drying (3–4 days); however, dehydrator drying was selected for the final product used in sensory evaluation due to its consistency and controlled conditions. Finally, the dried samples were deep-fried at 170–180 °C for 3–5 minutes until golden brown and crisp, where browning and flavor development are influenced by Maillard reactions during deep frying [9].

2.3 Treatments

Three formulations were prepared with varying quantities of jackfruit seeds: 75 g (T1), 150 g (T2), and 225 g (T3). The selection of these treatment levels was based on preliminary bench-top trials; the 75 g level established a baseline for workable dough consistency, while 225 g represented the maximum concentration that allowed the product to maintain structural integrity and expansion during frying. All other ingredients, including rice flour, water, and seasonings, remained constant across all treatments.

2.4 Respondents and Sampling

A total of 30 respondents participated in the study, selected through purposive sampling. This group consisted of 15 Food Service Management students (semi-trained panelists) and 15 food experts (trained panelists) from Cebu Technological University – Main Campus. A sample size of $n=30$ was utilized as it meets the requirement for sensory profiling to achieve statistical power in experimental food research while ensuring manageable controlled testing conditions.

2.5 Sensory Evaluation

Sensory evaluation was conducted using a 9-point hedonic scale (1 = dislike extremely; 9 = like extremely) to assess texture, crispiness, flavor, aroma, appearance, and overall acceptability. Sensory evaluation using hedonic scaling is widely applied in food product development to assess consumer preference [10,11]. To eliminate order bias, sample presentation was randomized using a balanced design. Samples were served in identical containers and identified only by random three-digit codes to ensure a double-blind assessment. Water was provided to cleanse the palate between sample evaluations.

2.6 Data Analysis

Descriptive statistics, including mean and standard deviation, were calculated to summarize the sensory results. The data were processed and analyzed using Microsoft Excel. One-way analysis of variance (ANOVA) was applied at a 0.05 level of significance to determine differences among treatments. Where significant differences were identified, a Tukey's Honestly Significant Difference (HSD) post-hoc test was performed to isolate specific differences between treatment means.

2.7 Ethical Considerations

Participation in the study was voluntary, and informed consent was obtained from all respondents prior to data collection. Respondents were informed about the purpose of the study and assured that their responses would be kept confidential and used solely for research purposes.

3. Results and Discussion

3.1. Sensory Acceptability of Jackfruit Seed Chicharon

The sensory acceptability of jackfruit seed-based chicharon was evaluated across six attributes using a 9-point Hedonic Scale. To ensure statistical rigor, the data were analyzed to determine how varying seed concentrations affect the final product's physical and organoleptic properties.

Table 1. Summary of Sensory Acceptability and One-Way ANOVA Results

Attribute	T1 (75g)	T2 (150g)	T3 (225g)	F-value	p-value	Interpretation
Texture	7.97 ± 1.07	6.97 ± 1.19	6.97 ± 1.59	5.9224	0.0039	Significant
Crispiness	8.23 ± 0.94	6.93 ± 1.05	7.23 ± 1.52	9.7055	0.0002	Significant
Appearance	8.10 ± 0.76	7.77 ± 1.07	7.23 ± 1.17	5.5773	0.0053	Significant
Flavor	7.80 ± 1.13	7.23 ± 1.10	7.13 ± 1.53	2.4161	0.0952	Not Sig.
Aroma	7.83 ± 1.02	7.33 ± 0.80	7.30 ± 1.09	2.8023	0.0662	Not Sig.
Overall	8.39 ± 0.71	7.25 ± 0.89	7.17 ± 1.14	—	—	—
<i>Significant at $p < 0.05$</i>						

3.1.1. Impact of Formulation on Texture and Crispiness

Treatment 1 (T1) obtained the highest ratings for texture (7.97 ± 1.07 , Like Very Much) and crispiness (8.23 ± 0.94 , Like Extremely). One-way ANOVA confirmed significant differences ($p < 0.05$) among treatments for these attributes, indicating that the proportion of jackfruit seeds directly influences the snack's structural matrix [6].

The superior texture of T1 (75g seeds) is likely due to the optimal balance between jackfruit seed starch and rice flour. During the steaming phase, starch gelatinization occurs as granules absorb water and swell, forming a viscoelastic gel [7]. In T1, the lower concentration of seeds allowed for a more uniform starch network. Upon deep-frying at 170–180 °C, the rapid evaporation of moisture content creates internal steam pressure, leading to the formation of the porous, "airy" cells characteristic of traditional chicharon.

This mechanism is consistent with findings on fried snack processing, where moisture loss and expansion during frying enhance crispiness [8]. In contrast, T2 and T3 (150g and 225g) recorded lower scores. Increasing the seed concentration introduces higher levels of fiber and protein, which can disrupt the continuous starch gel. This disruption often results in a denser, harder product that resists expansion during frying, as seen in previous studies on plant-based snack modifications [6,18].

3.1.2. Flavor and Aroma Analysis

Statistical analysis revealed no significant difference ($p > 0.05$) in flavor and aroma across all treatments. This suggests that while the seed proportion varied, the constant levels of seasonings and the Maillard reaction provided a consistent sensory profile [9]. During deep-frying, amino acids from the seeds and reducing sugars in the flour interact under high heat to produce the savory, "toasty" aroma and flavor characteristic of fried snacks [9]. Respondents found all treatments generally acceptable, with T1 being slightly preferred for its balanced flavor profile (7.80 ± 1.13).

3.1.3. Appearance and Overall Acceptability

Appearance scores were significantly higher for T1 (8.10 ± 0.76), linked to the frying mechanism. Proper expansion of the starch matrix results in a lighter, golden-brown color and a uniform surface "blistering" that visually mimics pork-based chicharon [8,9].

Table 2. Final Ranking and Consumer Feasibility

Rank	Treatment	Overall Mean	Verbal Description	Interpretation
1st	T1 (75g)	8.39	Like Extremely	Most Acceptable
2nd	T2 (150g)	7.25	Like Very Much	Highly Acceptable
3rd	T3 (225g)	7.17	Like Much	Acceptable

As shown in Table 2, T1 is the best-performing treatment. The overall mean of 7.60 across all treatments indicates that jackfruit seeds are a highly viable alternative ingredient. These findings support the potential of upcycling agricultural waste into sustainable snack products [15,17], aligning with current trends in food innovation and plant-based product development [1,4,5].

4. Conclusions

The findings of this study establish jackfruit (*Artocarpus heterophyllus*) seeds as a viable and highly acceptable raw material for the production of plant-based chicharon. The research confirms that the formulation with the lowest seed-to-flour ratio (T1) provides the optimal structural matrix required to replicate the crispiness and textural appeal of traditional pork-based snacks. This suggests that while jackfruit seeds are nutrient-dense, their concentration must be carefully balanced with starch-based binders to ensure proper expansion and consumer satisfaction.

4.1. Practical Implications

The development of this jackfruit seed chicharon offers significant opportunities for Small and Medium Enterprises (SMEs) and local food processors. By upcycling agricultural waste into a value-added product, producers can lower raw material costs while appealing to the growing market of health-conscious and vegetarian consumers. Furthermore, the established techno-guide serves as a standardized protocol for micro-enterprises, promoting consistent quality in small-scale production and contributing to local food security and waste reduction goals.

4.2. Study Limitations

While this study successfully evaluated sensory acceptability, it was limited to the organoleptic and textural assessment of the product. The scope did not include a formal shelf-life study or proximate analysis (nutritional labeling) to quantify the exact reduction in fat content compared to pork chicharon. Additionally, the sensory panel was localized to a specific academic institution, which may not fully represent the diverse palate of the broader national or international consumer base.

4.3. Recommendations for Future Research

Future research should prioritize comprehensive nutritional profiling and proximate analysis to formally quantify the health benefits of this seed-based alternative. Longitudinal shelf-life studies and rancidity testing are also recommended to identify optimal packaging materials that ensure product stability over time. Additionally, exploring advanced processing methods like vacuum or air frying could further minimize oil retention while maintaining high crispiness standards. Finally, expanding sensory testing to a larger, more diverse consumer demographic is essential to validate the product's broader market potential and commercial scalability.

Author Contributions: Conceptualization, I.I.D.; methodology, I.I.D. and A.C.O.T.; formal analysis, I.I.D. and A.C.O.T.; investigation, I.I.D. and A.C.O.T.; resources, I.I.D., A.C.O.T., and W.E.S.; data curation, I.I.D. and A.C.O.T.; writing—original draft preparation, I.I.D.; writing—review and editing, I.I.D. and A.C.O.T.; project administration, I.I.D. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethical review and approval were waived for this study due to the voluntary participation of respondents and the absence of potential risk. The study was conducted in accordance with ethical standards.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Acknowledgments: The authors express their sincere gratitude to Cebu Technological University for providing the academic environment and institutional support necessary for the completion of this study. The authors also extend their appreciation to the faculty members of the College of Education for their guidance and encouragement throughout the research process. Special thanks are given to the respondents for their voluntary participation and valuable contribution to the study.

Conflicts of Interest: The authors declare no conflict of interest.

References

- [1] F. Boukid, "Plant-based meat analogues: From niche to mainstream," *Critical Reviews in Food Science and Nutrition*, vol. 61, no. 2, pp. 294–312, 2021. <https://doi.org/10.1080/10408398.2020.1741505>
- [2] S. Kumar et al., "Nutritional and functional properties of jackfruit seeds: A review," *International Journal of Food Science & Nutrition*, vol. 71, no. 3, pp. 245–256, 2020.
- [3] T. Thatsanasuwan et al., "Nutritional composition of jackfruit seed flour," *International Journal of Food Science*, vol. 2023, pp. 1–10, 2023.

-
- [4] J. P. Reyes et al., "Development and sensory acceptability of plant-based chicharon alternatives," *Asia Pacific Journal of Multidisciplinary Research*, vol. 8, no. 3, pp. 112–120, 2020. [Online]. Available: <https://apjmr.com>
- [5] N. González et al., "Acceptance of plant-based chicharon alternatives," *Journal of Food Science and Technology*, vol. 58, no. 3, pp. 1024–1032, 2021.
- [6] M. C. Magat et al., "Effect of drying methods on texture of plant-based fried snacks," *Philippine Journal of Food Science and Technology*, vol. 14, no. 2, pp. 45–53, 2021.
- [7] S. Reddy et al., "Starch gelatinization and food texture modification," *International Journal of Food Science*, vol. 56, no. 4, pp. 1903–1915, 2021. <https://doi.org/10.1111/ijfs.14920>
- [8] J. Ahmed et al., "Effect of dehydration on texture and shelf life of fried snack foods," *Journal of Food Processing and Preservation*, vol. 44, no. 6, Art. no. e14452, 2020. <https://doi.org/10.1111/jfpp.14452>
- [9] M. Mellema, "Maillard reaction in deep-fried snacks," *Food Chemistry*, vol. 318, 126484, 2020. <https://doi.org/10.1016/j.foodchem.2020.126484>
- [10] J. Lim, "Sensory evaluation in food science," *Current Opinion in Food Science*, vol. 43, pp. 56–63, 2022. <https://doi.org/10.1016/j.cofs.2021.12.003>
- [11] H. Stone and J. L. Sidel, *Sensory Evaluation Practices*, 4th ed. Academic Press, 2020.
- [12] R. Kushwaha et al., "Jackfruit seed flour-based waffle cone optimization," *Heliyon*, vol. 9, no. 2, e13140, 2023. <https://doi.org/10.1016/j.heliyon.2023.e13140>
- [13] S. Mohammed et al., "Valorisation of jackfruit seed flour in bakery products," *Food Science and Biotechnology*, vol. 33, no. 3, pp. 3167–3180, 2024.
- [14] W. A. M. P. Kaushalya et al., "Development of gluten-free biscuits using jackfruit seed flour," *Journal of Food Science and Technology*, vol. 61, no. 4, pp. 1234–1242, 2024.
- [15] S. Rattan et al., "Utilization of food waste for sustainable product development," *Journal of Food Science & Technology*, vol. 58, no. 6, pp. 2347–2360, 2021.
- [16] C. González et al., *Sustainable Food Innovation: Concepts and Applications*. Springer, 2022.
- [17] J. Gustavsson et al., *Global Food Losses and Food Waste: Causes and Prevention*. FAO, 2021.
- [18] J. Ahmed et al., *Food Hydrocolloids: Functional and Technological Applications*. CRC Press, 2020.
- [19] I. E. Dizon, "Utilization of jackfruit seed flour in baked goods and noodles," *Philippine Journal of Food Science*, vol. 47, no. 2, pp. 123–130, 2018.
- [20] R. Kumar et al., "Nutritional and functional properties of jackfruit seed flour," *International Journal of Food Science and Technology*, vol. 53, no. 6, pp. 1435–1442, 2018. <https://doi.org/10.1111/ijfs.13793>