Business Fora: Business and Allied Industries International Journal
2026, Vol. 6, No.2, 155 – 166 | ISSN Online: 3028-1326 | ISSN Print: 3028-1334
DOI: https://doi.org/10.62718/vmca.bf-baiij.6.2.SC-0126-021

Sensory Acceptability of Talisay (Terminalia catappa) Seeds as Sandwich Spread

Article History:

Initial submission: 14 January 2026
First decision: 18 January 2026
Revision received: 17 February 2026
Accepted for publication: 20 February 2026
Online release: 26 February 2026

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Abstract

This experimental study investigated the sensory acceptability of a sandwich spread developed from Talisay (Terminalia catappa) seeds. The study aimed to evaluate the product in terms of appearance, aroma, flavor, texture, spreadability, and overall acceptability. A total of 150 student panelists from Iloilo State University of Fisheries Science and Technology were selected through stratified random sampling, thereby ensuring representative participation across three distinct colleges. The panelists assessed the sandwich spread using a modified 5-point hedonic scale, and data were analyzed using mean scores and the Kruskal–Wallis test to determine differences among sensory attributes. Results indicated that all sensory attributes were rated as "Highly Acceptable," with mean scores ranging from 4.12 to 4.24. Aroma received the highest score, while flavor obtained the lowest, though still within the highly acceptable range. The Kruskal–Wallis analysis revealed no statistically significant differences across the sensory attributes ($p > 0.05$), suggesting consistent and favorable evaluations across all criteria. The findings demonstrate that Talisay seeds are a viable ingredient for developing a nutritionally promising and culturally relevant sandwich spread. This study highlights the potential of utilizing underutilized indigenous plant resources in food innovation, promoting sustainability, and providing an alternative, locally sourced spread for consumers.

Keywords: Talisay seed, sandwich spread, sensory evaluation, food innovation, indigenous plant resources

INTRODUCTION

Sandwich spreads, locally referred to as "palaman," are essential components of everyday food consumption in many Filipino households. Commonly paired with bread or buns, spreads such as cheese spread, mayonnaise, and peanut butter are valued for their convenience, affordability, and sensory appeal, reflecting contemporary Filipino eating habits influenced by both local and Western food cultures (Del Mundo & Magpantay, 2019). These spreads function as spreadable condiments that enhance flavor, improve texture, and provide moisture to sandwiches, and in some cases serve as the primary filling, such as peanut butter–based products (Breaddad, 2020). Despite their popularity, most commercially available sandwich spreads are highly processed, often high in fat, sugar, and preservatives, and largely dependent on imported raw materials, raising concerns related to nutrition, affordability, and sustainability (Food and Agriculture Organization [FAO], 2021).

In recent years, increasing consumer awareness of health, food security, and environmental sustainability has driven interest in the development of alternative food products derived from indigenous and underutilized plant resources. The FAO (2021) emphasizes that strengthening indigenous food systems and promoting locally sourced ingredients are crucial strategies for achieving sustainable diets and reducing reliance on imported food products. Plant-based food innovations, particularly nut-based spreads, have gained attention due to their nutritional value, functional properties, and potential to support sustainable food systems (Singh et al., 2020). Within this context, exploring locally available ingredients for sandwich spread development presents an opportunity to address both

nutritional concerns and local resource utilization.

One such underutilized resource is Terminalia catappa Linn., commonly known as Talisay or Indian almond. Talisay is a tropical tree belonging to the family Combretaceae and is widely distributed across Asia, Africa, and Australia. In the Philippines, it is commonly planted for ornamental and shade purposes, particularly in coastal and urban areas (Orwa et al., 2009). Although the tree is abundant, its fruits are often overlooked, and the edible seeds are frequently discarded. Previous studies have demonstrated that Talisay seeds possess significant nutritional and functional value. Anand et al. (2015) reported that Terminalia catappa seeds contain bioactive compounds with notable phytopharmacological importance, while Chukwuma et al. (2019) identified antioxidant and anti-hyperglycemic properties, suggesting potential health benefits. The seeds are also rich in protein, lipids, and essential minerals, with a nutritional profile comparable to commonly consumed nuts such as almonds (Singh et al., 2020).

Despite these documented nutritional and functional properties, the application of Talisay seeds in food product development remains limited. Locally, Gonzales and Ramos (2018) demonstrated the feasibility of using Talisay seeds in nut-based polvoron, indicating their potential as an ingredient in processed food products. However, existing studies have largely focused on confectionery products, oil extraction, or medicinal applications, with no documented research on the use of Talisay seeds as a primary ingredient in sandwich spreads. This gap highlights the underutilized potential of Talisay seeds in the development of nut-based spreads, a product category that has been widely explored using peanuts and other nuts but not indigenous alternatives.

Addressing this gap is significant in the context of indigenous food innovation and sustainability. Padua (2017) emphasized that the development of food products using locally sourced and underutilized ingredients contributes to cultural preservation, economic resilience, and sustainable food systems in the Philippines. Developing a sandwich spread from Talisay seeds may offer a nutritious, affordable, and culturally relevant alternative to conventional spreads while reducing dependence on imported ingredients and supporting local agricultural resources.

In view of these considerations, this study seeks to contribute to food product innovation by developing a sandwich spread using Talisay (Terminalia catappa) seeds and evaluating its acceptability. Specifically, the study aims to formulate sandwich spreads using varying proportions of Talisay seed paste, assess their sensory attributes in terms of appearance, aroma, taste, texture, spreadability, and overall acceptability, and determine whether significant differences exist among the developed formulations. Through this investigation, the study intends to establish the potential of Talisay seeds as a nutritious, locally sourced, and culturally relevant alternative ingredient for sandwich spread development.

Objectives of the Study. This study aims to develop a sandwich spread using Talisay (Terminalia catappa) seeds and to determine its level of acceptability as a potential alternative sandwich spread. Specifically, the study seeks to:

1. Formulate sandwich spreads using varying proportions of Talisay seed paste;

2. Evaluate the sensory attributes of the developed sandwich spreads in terms of appearance, aroma, taste, texture, spreadability, and overall acceptability; and

3. Determine whether there are significant differences in the level of acceptability among the different sandwich spread formulations.

Conceptual Framework. This study is anchored on the Input–Process–Output (IPO) model, which illustrates the systematic progression of activities involved in the development and

evaluation of a sandwich spread using Talisay (Terminalia catappa) seeds. The framework presents a logical flow from formulation to sensory evaluation, statistical analysis, and the establishment of the product's potential, ensuring clarity in the relationship among the variables of the study. The input component of the framework consists of the formulation variables and sensory attributes considered in the study. Three sandwich spread formulations were developed using varying proportions of Talisay seed paste: Formulation A containing 100% Talisay seed paste (250 g) with no added oil; Formulation B containing 50% Talisay seed paste (125 g) with ¼ cup oil; and, Formulation C containing 25% Talisay seed paste (62.5 g) with ¼ cup oil.

These formulations served as the independent variables of the study. The sensory attributes evaluated—namely appearance, aroma, taste, texture, spreadability, and overall acceptability—represent the key indicators used to assess consumer acceptance of the developed products. The framework is further grounded on the nutritional, cultural, and sustainability rationale for utilizing Talisay seeds, recognizing their potential as a locally available and underutilized resource that can contribute to food innovation and sustainable food systems.

The process component describes the methodological steps undertaken to transform the inputs into measurable outcomes. This phase begins with the formulation of the sandwich spreads using the specified proportions of Talisay seed paste. Data collection is then carried out through sensory evaluation using a structured survey questionnaire administered to selected evaluators. The sensory data gathered are subjected to statistical treatment using the Kruskal–Wallis test to determine whether significant differences exist in the level of acceptability among the three formulations. This analytical step serves as a validating mechanism that strengthens the objectivity and reliability of the sensory evaluation results. The findings are subsequently analyzed and interpreted to provide meaningful insights into the comparative performance of each formulation. A feedback mechanism is inherent in the framework, indicating that the results of the evaluation and analysis may inform future refinement of the formulations or guide further product development and possible scale-up.

The output component of the framework consists of the determined levels of sensory attributes of the developed sandwich spreads in terms of aroma, taste, texture, spreadability, and overall acceptability. More importantly, the framework culminates in a conclusion regarding the potential of Talisay seeds as a nutritious, culturally relevant, and locally sourced alternative ingredient for sandwich spread development. By synthesizing the results of formulation, sensory evaluation, and statistical analysis, the study contributes to the promotion of indigenous food resources, supports local ingredient valorization, and advances sustainable and innovative food product development.

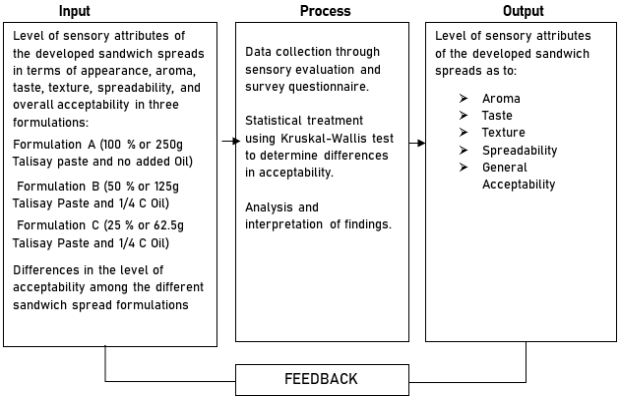

Figure 1
The Conceptual Paradigm Depicting the Relationship Between Variables

LITERATURE REVIEW

A sandwich spread is a food product characterized by its soft and spreadable consistency, commonly used to enhance the flavor, texture, and nutritional value of sandwiches. Traditional sandwich spreads include butter, mayonnaise, mustard, and ketchup, as well as composite dressings such as Thousand Island, tartar sauce, and Russian

dressing. Beyond conventional options, spreads may also be categorized as dairy-based (e.g., cheese and cream spreads), plant-based (e.g., jams, hummus, nut butters), yeast-based (e.g., Vegemite), and meat-based (e.g., pâté). In recent years, plant-based spreads have gained increased attention due to their relatively lower environmental impact in terms of land use, water consumption, and greenhouse gas emissions compared to animal-based spreads (Poore & Nemecek, 2018).

Among widely consumed plant-based spreads, peanut butter and almond butter are notable for their high protein and healthy fat content. Peanut butter, produced from ground roasted peanuts, is consumed globally and valued for its affordability and nutritional density (Settaluri et al., 2012). Almond butter, while nutritionally rich in monounsaturated fats, vitamins, and minerals, is often more expensive and less accessible in developing countries (Berryman et al., 2011). These limitations have prompted interest in exploring alternative, locally available plant-based raw materials that can provide comparable nutritional benefits while supporting food sustainability and local agricultural resources.

One such promising ingredient is Talisay (Terminalia catappa), commonly known as the Indian almond tree. Talisay is widely distributed in tropical regions, including the Philippines, and produces edible seeds with a flavor profile similar to almonds. The seeds are rich in essential minerals such as potassium, calcium, magnesium, and sodium, and contain a fixed oil known as Indian almond oil, which is suitable for culinary applications (Thomson & Evans, 2006). Beyond its nutritional value, T. catappa is recognized for its multifunctionality: its leaves are used in traditional medicine for antimicrobial and anti-inflammatory purposes; its kernels are consumed directly or processed into oil; and its wood and bark are used for construction materials, tannins, and dyes (Nadendla et al., 2012).

Several studies have explored the potential of Talisay seeds and oil for non-spread applications. Ramos et al. (2012) investigated Talisay seeds as an alternative source of cooking oil and reported that oil extracted from dried seeds exhibited physicochemical properties comparable to high-quality palm oil, including acceptable viscosity, color, and smoke point. Similarly, La Salles (2007) evaluated Talisay oil for biodiesel production and found its fatty acid composition and stability to be suitable for industrial use. Medicinal studies have also demonstrated lipid-lowering and antitumor properties of T. catappa seed extracts, further supporting its functional value (Nadendla et al., 2012). However, despite these documented uses, existing literature remains largely focused on oil extraction, medicinal properties, and industrial applications.

A notable gap in existing research is the lack of studies exploring the utilization of Talisay seeds as a sandwich spread or paste-based food product. To date, there is no documented research that specifically examines the formulation, sensory attributes, and consumer acceptability of sandwich spreads developed from Talisay seed paste. This absence highlights the novelty and necessity of the present study, particularly in the context of developing value-added food products from underutilized local resources.

Sensory evaluation plays a critical role in the development and acceptance of new food products. Attributes such as appearance, aroma, taste, texture, spreadability, and overall acceptability are essential determinants of consumer preference (Lawless & Heymann, 2010). Hedonic sensory evaluation methods are commonly employed to assess consumer responses and compare acceptability across different formulations (Stone et al., 2012). Numerous studies on food spreads and similar products have emphasized the importance of sensory evaluation in identifying optimal formulations and ensuring market viability (Meilgaard et al., 2016). Incorporating standardized sensory evaluation methods strengthens the methodological foundation of product development studies, including the present research.

From a cultural and market perspective, there is growing consumer demand for plant-based, sustainable, and locally sourced food products. The global shift toward plant-based diets is driven by health consciousness, environmental concerns, and interest in traditional and indigenous food ingredients (Mintel, 2020). In the Philippine context, the utilization of locally abundant resources such as Talisay seeds aligns with national goals for food innovation, waste reduction, and rural livelihood development. Developing a sandwich spread from Talisay seeds not only promotes nutritional and functional benefits but also enhances cultural relevance by transforming a familiar yet underutilized ingredient into a value-added product suitable for modern consumption.

Overall, the reviewed literature establishes the nutritional, functional, and economic potential of Terminalia catappa while revealing a clear research gap in its application as a sandwich spread. Addressing this gap through product formulation and sensory evaluation supports the development of innovative, nutritious, and culturally relevant plant-based food alternatives.

METHODOLOGY

This study employed an experimental research design, which is widely used in food science and culinary research to determine cause-and-effect relationships between variables. Experimental research involves the deliberate manipulation of an independent variable while controlling other factors to observe its effects on a dependent variable under controlled conditions. This method is particularly useful in developing and evaluating food products because it allows the researcher to assess how variations in formulation affect the sensory attributes and acceptability of the final product. In this study, the independent variable was the proportions of Talisay seed used in the sandwich spread, while the dependent variable was the overall sensory acceptability, including aroma, color, texture, flavor, and general acceptability (Bhaskaran, 2022).

Ingredients. The sandwich spread was prepared using Talisay (Terminalia catappa) seeds as the primary base in three different formulations. Formulation A (100 % or 250g Talisay paste and no added Oil); Formulation B (50 % or 125g Talisay Paste and 1/4 C Oil); and, Formulation C (25 % or 62.5g Talisay Paste and 1/4 C Oil) to determine the optimal ratio for sensory acceptability. The primary ingredients included ground Talisay seed paste and complementary flavoring agents such as salt, sugar, and oil to improve texture and spread ability, smoothness and mouthfeel.

Materials and Equipment. The materials and equipment utilized in this study included measuring cups and spoons, weighing scale, mixing bowls, rubber spatulas, wooden spoons, food processors for grinding and mixing the Talisay seeds. For thermal processing, ovens and heating plates were used to toast and cook the seeds before grinding it into paste. Additional equipment included timers to standardize processing times, and containers for proper storage and presentation during sensory evaluation. The preparation and evaluation were conducted in the HRM Food Laboratory of Iloilo State University of Fisheries Science and Technology, ensuring a controlled environment for consistent results.

Preparation Procedures. The preparation of the Talisay seed sandwich spread followed a standardized procedure to ensure uniformity and consistency across all formulations. Mature Talisay seeds were first collected and thoroughly cleaned to remove adhering dirt and impurities. The hard seed shells were carefully cracked, and the kernels were separated from the seed pods. The extracted seeds were roasted at a controlled temperature to enhance flavor and reduce moisture content. After cooling, the roasted seeds were processed using a food processor until a smooth and homogeneous paste was obtained. The Talisay seed paste was then accurately measured according to the designated treatments and combined with sugar, salt, and oil in varying proportions to produce three formulations with different concentrations of Talisay seed paste.

Each formulation was mixed thoroughly until a uniform and spreadable consistency was achieved. Finally, the prepared sandwich spreads were transferred into sterilized, airtight containers and stored under refrigerated conditions prior to sensory evaluation.

Sensory Evaluation. Once prepared, the sandwich spreads were cooled and presented to respondents for sensory evaluation. Respondents assessed aroma, color, flavor, texture, and overall acceptability using a modified five-point hedonic scale, ranging from "Not Acceptable" to "Extremely Acceptable." This scale allowed for objective measurement of preferences and perception across different formulations. Data from the sensory evaluation were statistically analyzed using the Kruskal-Wallis H test to determine significant differences in acceptability among the three formulations.

Population, Setting, and Sampling Technique. The sensory evaluation of the Talisay seed sandwich spread was conducted with one hundred fifty (150) panelists who served as respondents to assess the acceptability of the developed formulations. The number of panelists was selected based on established guidelines for hedonic testing, which recommend a sample size of 100–200 participants to obtain reliable estimates of consumer preference while maintaining manageable logistical requirements (Meilgaard, Civille, & Carr, 2016; Stone, Bleibaum, & Thomas, 2012).

Respondents were drawn from Iloilo State University of Fisheries Science and Technology (ISUFST), Ilaya First, Municipality of Dumangas, Iloilo, representing three different colleges: 50 students from the College of Information Technology, 50 students from the College of Education, and 50 students from the College of Hospitality Management. This stratification ensured a diverse pool of participants with varying academic backgrounds, reflecting a broad spectrum of potential consumers.

A stratified random sampling technique was employed, whereby the population was divided into three college strata, and participants were randomly selected within each stratum. This approach helped achieve proportional representation from each group and reduced the risk of selection bias (Creswell, 2014).

It is important to note that the panelists were untrained, which may introduce greater variability in responses compared to trained sensory evaluators. However, untrained panelists are appropriate for hedonic testing because they represent real-world consumers, providing insight into the general acceptability of the product in typical consumption settings (Lawless & Heymann, 2010). While random selection and stratification improve representativeness, the results reflect consumer preference rather than precise sensory profiling, and this limitation is acknowledged in interpreting the findings.

Survey Instrument. To assess the acceptability of the developed Talisay (Terminalia catappa) seed sandwich spread, this study utilized a sensory evaluation score sheet based on a modified five-point Hedonic Scale. The Hedonic Scale is widely used in experimental research to measure consumer preferences and product acceptability, allowing respondents to rate their degree of liking or disliking for specific attributes such as aroma, color, texture, flavor, and overall acceptability (Meilgaard, Civille, & Carr, 2016). Using this standardized tool ensured objective data collection and enabled systematic analysis of consumer perceptions regarding the different formulations of the sandwich spread.

Table 1
Hedonic scale in measuring the level acceptability

Scale	Range	Responses
5	4.21 – 5.00	Extremely Acceptable (EA)
4	3.41 – 4.20	Very Acceptable (VA)
3	2.61 – 3.40	Moderately Acceptable (MA)
2	1.81 – 2.60	Slightly Acceptable (SA)
1	1.00 – 1.80	Not Acceptable (NA)

The survey instrument was validated by a panel of four (4) expert professors from the college of hospitality management who evaluated the items in terms of clarity, relevance, and appropriateness in relation to the objectives of the study. The comments, suggestions, and recommendations provided by the experts were carefully reviewed and incorporated in the revised version of the instrument to enhance its reliability and applicability.

After content validation, the instrument was pilot tested among respondents representing the three categories involved in the study, namely fifteen (15) senior high school students, fifteen (15) homemakers, and fifteen (15) high school teachers, for a total of forty-five (45) participants. The pilot testing was conducted to assess the construct validity and reliability of the instrument.

The sensory evaluation instrument used in this study is a hedonic rating scale which assessed the appearance, aroma, taste, texture, spreadability, and overall acceptability. The instrument was subjected to a pilot testing with 20 respondents who were similar in profile with the main participants. The purpose of the pilot test is to assess the clarity, relevance, and consistency of the instrument.

Validity was established through content validation, in which a panel of experts in food science and sensory evaluation reviewed the instrument to ensure that each item appropriately measured the intended sensory attribute. Feedback from the experts was incorporated to improve item clarity and coverage, ensuring the instrument was suitable for evaluating the sensory characteristics of the Talisay seed sandwich spread.

Reliability was assessed using Cronbach's alpha to determine the internal consistency of the instrument. The analysis yielded a Cronbach's alpha of 0.985, indicating excellent reliability. This suggests that the items on the hedonic scale consistently measured the sensory attributes across respondents. It is important to note that reliability reflects the consistency of responses rather than absolute accuracy, while validity reflects the appropriateness of the instrument for its intended purpose. Therefore, while the instrument is considered valid and highly reliable, it does not guarantee perfect measurement of sensory perceptions.

The results of the pilot test confirmed that the hedonic scale was suitable for assessing the sensory attributes and overall acceptability of the Talisay seed sandwich spread, providing confidence in the instrument's use for the main sensory evaluation.

Data Analyses. The data collected from the sensory evaluation of the Talisay (Terminalia catappa) seed sandwich spread were analyzed using appropriate quantitative statistical tools to ensure accurate interpretation of results. The mean was computed to determine the level of acceptability of the sandwich spread based on specific sensory attributes, including aroma, color, texture, flavor, and overall acceptability. This allowed the researcher to obtain an overall measure of acceptability across the different respondent categories, which included HRM students, homemakers, and local sandwich spread vendors.

To determine whether there were significant differences in the acceptability of the sandwich spread among the different formulations, the Kruskal-Wallis H test was employed. This non-parametric statistical test was used to compare the sensory responses across multiple independent groups and to assess whether variations in the proportions of Talisay seed significantly influenced respondents' perceptions. The Kruskal-Wallis test was chosen because it is well-suited for analyzing ranked data when the assumptions of normality are not satisfied, as is common in sensory evaluation studies.

All statistical computations were performed using the Statistical Package for the Social Sciences (SPSS) software. This approach ensured that the analysis of sensory scores was systematic, accurate, and reliable,

providing a solid basis for identifying the most acceptable formulation of the Talisay seed sandwich spread.

RESULTS

Level of Acceptability of Talisay Seed in Making Sandwich Spread as to Aroma, Color, Flavor, Texture and General Acceptability. Table 2 presents the level of acceptability of Talisay (Terminalia catappa) seed in making sandwich spread in terms of appearance, aroma, flavor, texture, spreadability, and general acceptability as evaluated by 150 respondents. The findings indicate that all sensory attributes were rated Highly Acceptable, with mean scores ranging from 4.12 to 4.24, suggesting a consistently favorable evaluation of the product.

Among the indicators, Aroma obtained the highest mean rating (M = 4.24, SD = 0.58), indicating that the respondents found the smell of the Talisay seed sandwich spread particularly appealing. This was followed closely by General Acceptability (M = 4.22, SD = 0.57), implying that the overall quality of the product was positively perceived by the respondents.

Texture (M = 4.20, SD = 0.61) and Appearance (M = 4.18, SD = 0.63) also received high mean ratings, demonstrating that the consistency and visual appeal of the sandwich spread met the expectations of the evaluators. Spreadability obtained a mean score of 4.15 with a standard deviation of 0.65, indicating that the product was generally considered easy to spread and suitable for sandwich preparation.

Although Flavor received the lowest mean score among the indicators (M = 4.12, SD = 0.69), it still fell within the "Highly Acceptable" range, suggesting that the taste of the sandwich spread was satisfactory to the respondents.

The overall weighted mean of 4.19 with a total standard deviation of 0.62 further indicates a high level of acceptability with minimal variability in responses. These results suggest that Talisay seeds are an effective ingredient for developing a sandwich spread with desirable sensory qualities and strong consumer acceptance.

Table 2
Level of Acceptability of Talisay Seed in Making Sandwich Spread as to Aroma, Color, Flavor, Texture and General Acceptability

Indicators	Mean	SD	Verbal Interpretation
Appearance	4.18	0.63	Highly Acceptable
Aroma	4.24	0.58	Highly Acceptable
Flavor	4.12	0.69	Highly Acceptable
Texture	4.20	0.61	Highly Acceptable
Spread ability	4.15	0.65	Highly Acceptable
General Acceptability	4.22	0.57	Highly Acceptable
Overall Weighted Mean	**4.19**	0.62	**Highly Acceptable**

Significant Difference in the Level of Acceptability of Talisay Seed in Making Sandwich Spread as Aroma, Color, Flavor, Texture and General Acceptability. Table 3 presents the results of the Kruskal–Wallis test conducted to determine whether there were significant differences in the level of acceptability of the Talisay seed sandwich spread in terms of appearance, aroma, flavor, texture, spreadability, and general acceptability. The findings revealed that all computed p-values were greater than the 0.05 level of significance, indicating that there were no statistically significant differences among the evaluated sensory attributes.

Specifically, appearance obtained an H-value of 1.245 with a p-value of 0.264, while aroma recorded an H-value of 0.892 and a p-value of 0.345. Flavor yielded an H-value of 2.103 with a p-value of 0.147, and texture had an H-value of 1.578 with a p-value of 0.209. Spreadability registered an H-value of 1.436 with a p-value of 0.231, indicating that respondents' evaluations of ease of spreading did not significantly differ. General acceptability obtained the lowest H-value of 0.735 with a p-value of 0.391.

The overall result (H = 1.311, p = 0.252) further confirmed that there was no significant difference in the level of acceptability across all attributes of the Talisay seed sandwich spread.

These results suggest that the respondents provided consistent and uniform evaluations of

the product across all criteria. The absence of significant differences implies that the Talisay seed sandwich spread demonstrated a balanced sensory quality, with all attributes contributing equally to its overall acceptability.

Table 3
Significant Difference in the Level of Acceptability of Talisay Seed Sandwich Spread

Indicators	H-value	p-value	Verbal Interpretation
Appearance	1.245	0.264	No significant difference
Aroma	0.892	0.345	No significant difference
Flavor	2.103	0.147	No significant difference
Texture	1.578	0.209	No significant difference
Spread ability	1.436	0.231	No significant difference
General Acceptability	0.735	0.391	No significant difference
Overall	**1.311**	**0.252**	**No significant difference among attributes**

p>.05 alpha

DISCUSSION

The sensory evaluation of the Talisay (Terminalia catappa) seed sandwich spread demonstrated that all assessed attributes—appearance, aroma, flavor, texture, spreadability, and overall acceptability—were rated as highly acceptable by the 150 respondents. The highest mean score was observed for aroma, suggesting that the natural nutty scent of the Talisay seeds was particularly appealing and may play a key role in consumer preference. Flavor, although slightly lower than other attributes, still fell within the "highly acceptable" range, indicating that the taste of the product was well-received. The uniformity of responses across all sensory attributes, confirmed by the Kruskal–Wallis test showing no significant differences ($p > 0.05$), suggests that the spread exhibits a balanced sensory profile in which each characteristic contributes positively to overall consumer satisfaction. Practically, these findings imply that Talisay seeds can be formulated into a spread that is not only palatable but also consistent in quality across multiple sensory dimensions.

When compared to existing literature, the results align with prior studies highlighting the potential of Talisay seeds in food product development. For instance, Gonzales and Ramos (2018) successfully developed nut-based polvoron using Talisay seeds, reporting high acceptability due to the seeds' natural flavor and nutritional content. Similarly, Singh, Kaur, and Sharma (2020) emphasized that nut-based spreads are generally well-accepted when they balance texture, aroma, and flavor. This study extends these findings by demonstrating the application of Talisay seeds in a novel product category, under spreadable condiments, offering new insights into its versatility and potential as a culturally relevant food ingredient.

The broader implications of this study are significant. Nutritionally, Talisay seeds provide protein, healthy fats, and essential minerals, offering a plant-based alternative to traditional spreads such as peanut butter or cheese spreads, which are often high in saturated fat and sugar (Adewuyi et al., 2014; Janporn et al., 2015). Culturally, the development of a sandwich spread from an indigenous and underutilized resource supports local food innovation and valorizes a Filipino native ingredient. Economically, it provides opportunities for value-added processing, reduces dependence on imported ingredients, and encourages sustainable utilization of local crops.

Despite these positive outcomes, the study has some limitations. First, the sensory evaluation involved untrained panelists who, while representative of potential consumers, may have introduced variability in responses. Second, the sample was limited to students from a single university, which may affect generalizability. Third, the study focused exclusively on sensory acceptability and did not include nutritional, shelf-life, or storage stability analyses, which are crucial for commercialization.

In conclusion, the study indicates that Talisay seed is a viable and highly acceptable ingredient for sandwich spreads, offering favorable sensory characteristics and potential nutritional benefits. For future research, it is recommended to refine the formulations to

optimize flavor and texture balance, expand sensory evaluation to a broader and more diverse population, conduct detailed nutritional profiling, and investigate shelf-life stability and preservation methods. Such steps would strengthen the feasibility of Talisay seed spreads for market introduction and contribute further to sustainable food innovation.

Conclusions. Based on the findings of the study, the following conclusions were drawn:

The Talisay (Terminalia catappa) seed was found to be a highly acceptable ingredient for developing a sandwich spread. All evaluated sensory attributes—appearance, aroma, flavor, texture, spreadability, and general acceptability—received mean scores ranging from 4.12 to 4.24, which fall within the "Highly Acceptable" range. These results indicate that respondents positively perceived the sensory quality of the developed product.

Among the evaluated attributes, aroma obtained the highest mean rating, suggesting that the nutty scent of the Talisay seed spread contributed strongly to consumer appeal. General acceptability also received high scores, reflecting an overall favorable perception of the product. Although flavor recorded the lowest mean among the attributes, it remained highly acceptable, indicating that taste was satisfactory and did not detract from the product's overall appeal. The consistently low standard deviations further indicate minimal variability in responses, demonstrating agreement among respondents.

The results of the Kruskal–Wallis test revealed no statistically significant differences in acceptability across the sensory attributes ($p > 0.05$). This implies that respondents evaluated all attributes consistently, and no single aspect significantly differed from the others. This balance suggests that the product has a uniform sensory profile, with all attributes contributing to its overall acceptability.

The study concludes that Talisay seeds are a viable and effective ingredient for sandwich spreads. The product exhibits highly acceptable sensory qualities and a balanced profile across all attributes, highlighting its potential as a nutritious, locally sourced, and culturally relevant food innovation suitable for further development and commercialization.

Recommendations. Based on the conclusions of the study, the following recommendations are proposed:

Formulation Refinement. Further product development is recommended to optimize flavor, texture, and spreadability, which may include experimenting with natural flavor enhancers or oil ratios to enhance consumer appeal.

Expanded Sensory Evaluation. Future studies should include a larger and more diverse panel of respondents, representing different age groups, regions, and socio-economic backgrounds, to improve the generalizability of results.

Nutritional and Functional Analysis. Conduct comprehensive nutritional profiling and functional property analyses (e.g., protein content, lipid profile, antioxidant activity) to strengthen the scientific basis for promoting Talisay seed spreads as a healthful alternative to commercially available spreads.

Shelf-Life and Storage Studies. Investigate storage stability, packaging, and preservation methods to ensure product quality and safety for commercial distribution.

Market Feasibility and Cultural Integration. Assess consumer willingness to purchase and market potential to support the introduction of Talisay seed spreads in local and regional markets, highlighting its cultural relevance and sustainable sourcing.

By implementing these recommendations, Talisay seed spreads can be further developed into a commercially viable and nutritionally beneficial product that supports local agriculture and sustainable food innovation.

Author contributions. (Not applicable)

Conflict of interest. The author declares no conflict of interest.

Funding source. This research received no external funding.

Artificial intelligence use. AI-assisted language editing was performed using ChatGPT; authors reviewed and approved all content.

Ethics approval statement. This study involved human respondents; however, formal ethical approval was not sought from the authors' institution. The authors affirm that participation was voluntary, informed consent was obtained, and confidentiality of responses was strictly maintained. No procedures were undertaken that posed risk or harm to the participants.

Data availability statement. All data supporting the findings of this study are included within the manuscript and its supplementary materials.

Acknowledgement. (Not available)

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