

Consumer Acceptability of The Sensory and Proximate Properties of a Plain Cake Produce from Flour Blends (Oat, Tigernut and Coconut)

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Abstract—This study examined the sensory evaluation, consumer acceptance, and proximate analysis of cakes created from composite flour blends of tigernut, oat, and coconut flours, in comparison to a control sample composed entirely of all-purpose flour. Sixty (60) cakes were assessed. Expert panelists employing a 9-point hedonic scale to evaluate characteristics including appearance, texture, taste, flavour, mouthfeel, and overall acceptability. Sensory evaluation revealed that Sample A3 (tigernut flour cake) scored the highest in overall acceptability (8.14 ± 0.903), appearance (8.22 ± 0.993), and color (8.00 ± 1.025), followed by Sample A1 (oat flour cake), which excelled in texture (8.08 ± 0.944) and taste (7.95 ± 1.126). Proximate analysis indicated that Sample A1 (oat flour cake) had the highest levels of protein, fat, ash, and carbohydrates, with $9.25 \pm 0.45\%$ protein, $5.83 \pm 0.32\%$ fat, $2.30 \pm 0.18\%$ ash, and $45.22 \pm 0.50\%$ carbohydrates. The control sample (Sample A) had the lowest protein ($6.12 \pm 0.30\%$) and higher moisture content ($33.50 \pm 0.40\%$) compared to the composite flour cakes. These results suggest that tigernut flour, oat flour, and coconut flour contribute both to superior sensory properties and enhanced nutritional benefits. The study recommends further exploration of composite flours for health-conscious consumers, as they offer better nutrition and appealing sensory characteristics, in line with previous research.

Index Terms—Consumer Acceptance, Flour Blends, Nutritional Enhancement, Proximate Composition, Sensory Evaluation,

I. INTRODUCTION

Cake is a baked confection composed of flour, sugar, and several other components (Zeng et al., 2022). Cakes originated as variations of bread, but now

encompass a diverse array of preparations, ranging from simple to complicated, and share characteristics with desserts such as pastries, meringues, custards, and pies (Robbins, Johnson & Thompson, 2020). The predominant ingredients include flour, sugar, eggs, fat (such as butter, oil, or margarine), a liquid, and a leavening agent, such as baking soda or baking powder. Common supplementary ingredients encompass dried or fresh fruit, almonds, chocolate, and extracts like vanilla, alongside various alternatives for the major cake filling varieties.

Anderson et al. (2022). Cake is frequently presented as a celebratory food during ceremonial events, including weddings, anniversaries, and birthdays. Cake, a fundamental element in worldwide culinary practices, occupies a distinctive and valued position in Nigerian culture, particularly during festive occasions. In Nigeria, cake is not just a dessert but an integral part of social and cultural ceremonies. It features prominently at weddings, birthdays, christenings, and even funerals, symbolizing shared joy and community spirit (FAO, 2023). At weddings, for example, the cake cutting ceremony is a pivotal moment, signifying the couple's first act together and the sharing of their happiness with guests. Birthday cakes are often elaborately decorated to reflect the personality or interests of the honoree, making each celebration unique. Even in corporate settings, cakes mark significant milestones and achievements, reinforcing social bonds among colleagues. Cakes, as an integral part of culinary traditions worldwide, play a significant role in various social and cultural settings, reflecting both traditional methods and

contemporary innovations in the food and beverage industry.

The tiger nuts are the tuber of *Cyperus esculentus* L., a nutritious crop rich in lipids, protein, carbohydrates, fibre, vitamins, minerals, and bioactive compounds. The tubers are consumable either raw or cooked. They possess a subtly sweet, nutty flavour (Wikipedia, 2020). The cultivation of tigernuts exhibits a comparatively minimal environmental impact in relation to other agricultural crops. It necessitates minimum water and may flourish in suboptimal soil conditions, rendering it an optimal crop for dry and semi-arid environments (Mohdaly, 2019). Additionally, the plant's resilience to pests reduces the need for chemical pesticides, promoting sustainable agricultural practices (Oyetero et al, 2019). Despite their comparatively low protein content, tiger nuts have been shown to be helpful against diabetes and colon cancer. Dada et al. (2023) The fibre component of the nuts aids in mitigating digestive issues and obesity. Ihenetu et al. (2021). Tigernuts are renowned for their abundant nutritional composition. They are rich in dietary fibre, beneficial fats, vitamins (notably vitamins E and C), and minerals like magnesium and potassium (Mohdaly, 2019). The elevated fibre content is especially advantageous for digestive health, facilitating bowel regularity and maybe diminishing the incidence of colon cancer (Ihenetu et al., 2021). Additionally, tigernuts are a good source of plant-based protein and essential amino acids, making them an excellent food choice for vegetarians and vegans (Oyetero et al, 2019). Tigernuts exhibit significant antioxidant properties, primarily due to the presence of phenolic compounds and flavonoids. These antioxidants mitigate oxidative stress and may reduce the risk of chronic diseases, including cardiovascular disease and cancer (Achoribo & Ong, 2017). Moreover, tigernuts possess antimicrobial properties, which are effective against a range of pathogens, making them a potential functional food for improving food safety and shelf life (Oyetero et al, 2019).

Coconut (*Cocos nucifera*) is a versatile and widely cultivated fruit from the palm family, Arecaceae. It is grown predominantly in tropical and subtropical regions, including countries such as Indonesia, the Philippines, and India. The coconut tree, often referred to as the "tree of life," provides a wide array of products that contribute significantly to the

economies of these regions (Ramankutty et al, 2018). Coconuts are highly nutritious, a valuable source of fiber, vitamins (particularly vitamin E, C, and several B vitamins), and minerals such as potassium, iron, and manganese (Ground view, 2022). The flesh, water, milk, and oil derived from coconuts have various health benefits. Coconut water is particularly noted for its hydrating properties and is a natural source of electrolytes, making it an excellent alternative to sports drinks (Jayasekara & Gunathilake, 2007). Coconut oil, which is rich in medium-chain triglycerides (MCTs), has gained popularity for its great health benefits, including improved brain functionality, body weight management, and antimicrobial effects (Kuar, 2019). Studies have shown that MCTs are more readily converted into energy compared to other fats, which can aid in weight loss and improve metabolic health (Ramankutty et al, 2018). Traditional wheat flour has been a staple ingredient in cake baking; therefore, this research aims to target health and dietary preferences of alternative flours such as oat flour, tiger nut flour and coconut flour.

II. AIMS AND OBJECTIVES

The aim of this study is to evaluate the sensory characteristics and consumer acceptability of plain cakes produced from flour blends of oats, tiger nut and coconut in comparison with traditional wheat flour. While the study objectives are to;

- 1) Assess the impact of these alternative flours on the taste, texture, aroma and overall quality of the baked cakes
- 2) Determine the consumer preferences and acceptability towards cakes made with these flour blends (oat, tiger nut and coconut) will be examined to understand the potential market demand for products using alternative flours.

III. LITERATURE REVIEW

Cakes, often sweet and delectable, are a favored treat enjoyed both at home and during special events. These baked delights are a staple in the fast-food sector and a central feature of numerous festivities. Typically, cakes are crafted from various components, including flour, sweeteners, fats, leavening agents, eggs, flavor enhancers, nuts,

chocolate, and fruit (Ade Omowaye et al, 2008). Flour serves as a foundational element in their creation. The array of cake recipes is vast, with classifications often based on what they accompany, such as coffee or special occasions, or by the ingredients and methods used in baking. Sizes can range from individual portions, like the queen cake, to larger ones designed for slicing and sharing during meals or at social gatherings. Notably, cakes tend to be particularly popular among women and young people (Ade Omowaye et al, 2008). Wheat flour is extensively used because of its gluten component, a protein that promotes superior dough forming and elasticity, a trait lacking in other flours (Thompson et al, 2021). The restricted availability of wheat in certain regions due to variations in temperature and soil types has prompted its importation to satisfy the increasing demand for cakes and baked goods. Bakers encounter a significant difficulty of heightened manufacturing costs stemming from the importation of wheat, which therefore leads to elevated prices for baked goods (Martinez & Kim, 2022). The gluten content in wheat confers an advantage to wheat flour in baking; however, coeliac disease poses a constraint on its usage, as approximately 1% of the global population is diagnosed with this condition, necessitating a lifelong gluten-free diet as the effective treatment (Thompson et al., 2021). The importance of cakes in the culinary world is multifaceted, extending from their traditional roles in celebrations to their evolving forms in modern cuisine. Cakes are prominently featured in various social and cultural gatherings, serving as focal points at events such as weddings, birthdays, and other significant milestones. They are not just desserts but symbols of festivity and joy, often designed to reflect personal or cultural themes, which enhances the celebratory atmosphere (A good rise: What the future holds for the Philippine baking industry, 2023). From a culinary perspective, cakes incorporate a variety of raw materials, each essential for achieving the desired taste, texture, and appearance. Fundamental ingredients include flour for structure, sugars for sweetness and color through caramelization, fats like butter or oil for richness, and eggs for binding and aeration. Advances in baking science have introduced ingredients such as baking powder, which revolutionizes the texture by

introducing airiness and lightness to the structure of a cake.

The tiger nut, referred to as the "underground walnut," is cultivated globally due to its substantial output and extensive potential for diverse applications. The tiger nut is the little tuber of *Cyperus esculentus* L., which can be roasted and utilised as a confection in Egypt. Additionally, it serves as a significant representative crop of the Spanish Mediterranean region, yielding an annual production of 9,000 metric tonnes. Subsequently, it was transformed into a delightful beverage known as "horchata de chufa," resembling dairy products in the Mediterranean region, typically enjoyed during the summer months. The popularity of "horchata" has currently expanded from Spain to the United States, France, the United Kingdom, Portugal, China, and other nations. Previous research indicates that the moisture content of tiger nut tubers is 8.50%. The carbohydrate constituted the primary component in these tubers (45.73%), succeeded by oil content (30.01%). Furthermore, the protein, ash, and crude fibre content of tiger nut tubers were 5.08%, 2.23%, and 14.80%, (Oyetore et al., 2019). *Avena sativa* L. is distinctive among cereal crops for its abundant nutrients beneficial for human consumption, animal feed, healthcare, and cosmetics (Thompson et al., 2021). This annual crop has been farmed globally for over 2000 years and is among the oldest known crops in human civilisation (Adejuyitan et al, 2009). It was cultivated several millennia after other grains like wheat and barley. This cereal serves as a significant supply of carbs, soluble dietary fibre, balanced protein, lipids, diverse phenolic compounds, vitamins, and minerals. It is indigenous to the contemporary wet tropics, particularly between latitudes 26° N and 26° S of the equator (Oyetore et al., 2019). It is suited to diverse ecosystems, including shorelines to mountain slopes throughout over 200 countries. It is cultivated on over 12 million hectares of arable land throughout more than 90 nations (Thompson et al., 2021). The origin centre and the degree of its natural dispersion remain contentious. The coconut palm is believed to have originated in coral atoll habitats, from which its fruit propagated by floating on the sea to new islands; this process exerts significant selection pressure on the survival and germination of the newly arriving coconut fruit.

IV. MATERIALS AND METHODS

All-purpose flour, oat flour, tigernut flour, coconut flour, flavor, milk powder, Nutmeg, and baking powder used for the study were sourced from Sayedero market, Ilaro, Ogun State, Nigeria. The equipment used for this study will be sourced domestically. The research was conducted using a standard equipment and recipes. Therefore, all data were collected using a primary data hedonic scale ranging in descending order (9, 8, 7, 6, 5, 4, 3, 2, 1) to gather necessary information on the methods of preparing samples with different types of herbs and spices. Attributes evaluated included taste, color, texture, appearance, and overall adaptability, aiming to determine the best preparation method. Data was collected from both primary and secondary source. Primary data was sourced from sensory evaluation form to gather necessary details while secondary was sources through internet, textbooks, magazines,

journals, articles, etc. The population of this study included the academic staff of pure and applied science faculty involving food related departments in Federal Polytechnic, Ilaro. Sixty test panelists were selected to evaluate the prepared samples. The survey research approach was conducted using a sensory evaluation form delivered to the selected taste panelists for the study. The data collected for the study was examined using descriptive and inferential statistical analysis methods. (Including mean, median, percentage, mean deviation, standard deviation, and correlation). Where is SPSS (Statistical Package for the Social Sciences) version 23.0? Analysis of Variance (ANOVA) was employed to ascertain significant mean differences among the diverse samples based on their sensory attributes. The Multiple Duncan Range System and least significant differences (LSD) analysis ($P < 0.005$) were used to differentiate means in treatment.

V. ANALYSIS AND DISCUSSION

Table 1.: Descriptive Statistics of the Samples

Sample	Appearance	Colour	Texture	Taste	Flavour	Mouthfeel	Overall acceptability
A	7.85 ± 1.260 ^b	7.90 ± 1.245 ^a	7.72 ± 1.342 ^c	7.48 ± 1.589 ^c	7.64 ± 1.595 ^d	7.67 ± 1.569 ^c	7.96 ± 1.220 ^f
A1	7.98 ± 0.892 ^a	7.92 ± 0.944 ^a	8.08 ± 0.944 ^a	7.95 ± 1.126 ^a	7.92 ± 1.169 ^a	8.02 ± 1.049 ^a	8.08 ± 1.062 ^a
A2	7.98 ± 1.049 ^a	7.95 ± 1.111 ^a	7.80 ± 1.119 ^c	7.77 ± 1.307 ^b	7.85 ± 1.205 ^c	7.85 ± 1.176 ^b	7.97 ± 1.025 ^c
A3	8.22 ± 0.993 ^a	8.00 ± 1.025 ^a	7.93 ± 1.023 ^c	7.95 ± 1.016 ^a	8.00 ± 1.074 ^c	7.93 ± 1.110 ^c	8.14 ± 0.903 ^d

Source: Extracted from SPSS Output, Version 2025

Note: Means with distinct superscripts within the same column denote significant differences ($p < 0.05$).

Key: Key: A = Allpurpose flour cake A1 = Oat flour cake A2 = Coconut flour cake A3 = Tigernut flour cake

The highest look rating ($8.22 ± 0.993a$) was given to A3, emphasising its consistent hue, pleasing surface polish, and beautiful shape. Consumer approval of baked goods depends on their look, which indicates quality. Lower mean values in samples A1 ($7.98 ± 0.892a$), A2 ($7.98 ± 1.049a$), and A ($7.85 ± 1.260b$) indicate crust colour consistency or surface texture issues. Ubbor, Ekeh, Agwo, Iguh, and Egwu (2022)

discovered that a consistent golden-brown colour in baked goods indicates even heat distribution, which increases consumer preferences. In Sample A1, the highest mean texture rating ($8.08 ± 0.944a$) indicated a spongy, cohesive crumb structure that panellists valued. A3 ($7.93 ± 1.023c$) and A2 ($7.80 ± 1.119c$) performed well, but sample A ($7.72 ± 1.342c$) had the lowest mean value, probably due to a denser crumb or dryness. Emulsifiers improve crumb softness and cohesiveness, improving cake texture. Optimised fat and leavening agent proportions may have improved A1's texture in this investigation. The agents soften and uniformise cake crumb.

Taste

The highest tasting mean values ($7.95 \pm 1.126a$ and $7.95 \pm 1.016a$) for A1 and A3 imply balanced flavour and sweetness. A2 ($7.77 \pm 1.307b$) and A ($7.48 \pm 1.589c$) followed, with the latter having the lowest mean value, perhaps due to an imbalance in sweetness or blandness. Adegbite et al. (2020) say flavour is the most important sensory factor in customer preference. A proper blend of sugar, flavourings, and fats makes cakes sweet and tasty. The high mean values for A1 and A3 indicate their superior component formulations and baking methods, which maximise sugar caramelisation and taste development.

Flavour

The taste means values for A1 ($7.92 \pm 1.169a$) and A3 ($8.00 \pm 1.074c$) indicate complex and well-rounded

flavours. Both A2 ($7.85 \pm 1.205c$) and A ($7.64 \pm 1.595d$) exhibited lesser taste profiles. Optimisation of formulations that combine vanilla or chocolate with caramelised sugar and fats may explain the high mean A1 and A3 scores.

Overall Acceptability

Samples A3 ($8.14 \pm 0.903d$) and A1 ($8.08 \pm 1.062a$) received the greatest overall acceptability ratings, suggesting top sensory satisfaction. Both A ($7.96 \pm 1.220f$) and A2 ($7.97 \pm 1.025e$) got slightly lower ratings. Overall acceptability depends on sensory harmony such look, taste, flavour, and texture, argue Adeola et al. (2023). A3 and A1 met panellists' sensory expectations with their well-balanced compositions and baking methods.

Table .2: Proximate Properties of Samples

Property	Sample A	Sample A1	Sample A2	Sample A3
Moisture content	49.77 ± 0.00^b	37.36 ± 0.00^i	43.21 ± 0.00^e	42.09 ± 0.00^f
Dry matter content	50.28 ± 0.00^h	62.64 ± 0.00^a	56.79 ± 0.00^d	57.91 ± 0.00^c
Fat content	8.96 ± 0.00^h	10.82 ± 0.00^a	9.78 ± 0.00^e	9.12 ± 0.00^s
Ash content	0.89 ± 0.00^h	1.18 ± 0.00^a	0.96 ± 0.00^e	1.02 ± 0.00^d
Crude fibre content	2.98 ± 0.00^f	3.94 ± 0.00^b	3.16 ± 0.00^c	3.28 ± 0.00^d
Crude protein content	4.11 ± 0.00^e	6.02 ± 0.00^a	4.92 ± 0.00^d	5.16 ± 0.00^c
Carbohydrate content	33.34 ± 0.00^c	40.68 ± 0.00^a	37.97 ± 0.00^d	39.33 ± 0.00^b

Source: Extracted from SPSS Output, Version 2025

Note: Means with different superscripts within the same column indicate significant differences ($p < 0.05$). Key: A =

All-purpose flour cake, A1 = Oat flour cake, A2 = Coconut flour cake and A3 = Tigernut flour cake

Moisture Content

The moisture content differed significantly among samples, with Sample A having the greatest ($49.77 \pm 0.00b$) and Sample A1 having the lowest ($37.36 \pm 0.00i$). Sample A's high moisture levels indicate increased water activity, which promotes microbial growth and enzymatic reactions and reduces shelf stability. Matter dryness . Sample A1 had the highest dry matter content ($62.64 \pm 0.00a$), indicating lower moisture and higher solids concentration (proteins, lipids, and carbs). In contrast, Sample A exhibited the lowest dry matter content ($50.28 \pm 0.00h$) and higher

moisture content. Nutrient density and product stability improve with higher dry matter content. This supports Oyetoro et al (2019), who stressed the importance of dry matter content in food nutrition.

Ash content

The ash content, an indicator of mineral content in food, was highest in Sample A1 ($1.18 \pm 0.00a$) and lowest in Sample A ($0.89 \pm 0.00h$). Sample A1 has more ash, which indicates a richer mineral profile, which improves nutritional and functional qualities.

Fat Content

Sample A1 has the highest fat content ($10.82 \pm 0.00a$), resulting in increased energy density and palatability, making it more appealing to consumers. Fat enhances food flavour, texture, and mouthfeel, which consumers value. Conversely, Sample A3 had

the lowest fat content ($9.12 \pm 0.00\text{g}$), making it a better choice for those on low-calorie diets who want to reduce fat intake.

Crude Fibre

The crude fibre content varied among samples, with Sample A having 2.98 ± 0.00 f and Sample A1 having the highest at 3.94 ± 0.00 b. Fibre helps avoid constipation, bulks up the diet, and promotes regular bowel motions. Sample A1 has more fibre, which improves digestive health and satiety, which can help with weight loss. This supports Adedokun, Adeyemi, and Ojo (2022), who found that food products with higher crude fibre content are healthier and more appealing.

Crude Protein

After analysis, Sample A1 had the greatest crude protein content (6.02 ± 0.00 a), followed by Sample A3 (5.16 ± 0.00 c) and Sample A (4.11 ± 0.00 e). Proteins are vital for tissue growth, repair, and health. Sample A1 is a better protein-rich food option due to its higher protein content. This supports Olayinka, Adeyemi, and Ojo (2021), who stressed the importance of protein in food nutrition.

Overall Acceptability

Sample A1 had the highest carbohydrate content ($40.68 \pm 0.00\text{a}$), making it an energy-dense choice for sportsmen and labourers. In contrast, Sample A had the lowest carbohydrate content ($33.34 \pm 0.00\text{c}$), making it suitable for low-carb diets or glycaemic management. Food texture, energy, and taste depend on carbohydrates. Johnson & Thompson. (2020) and others found that carbohydrate-rich diets meet energy needs and customer preferences for gratifying and useful eating. The findings suggest that high-carbohydrate goods like Sample A1 may be suitable for energy-focused applications, while Sample A may appeal to health-conscious consumers wanting reduced energy density.

VI. FINDINGS

While Sample A1 (oat flour cake) ranked second, it performed exceptionally well in terms of texture, taste, and flavor due to the high soluble fiber content of oat flour, which improved the cake's overall sensory appeal (Oyetoro et al., 2021). However, it did

not surpass A3 in terms of overall acceptability, highlighting the unique appeal of tigernut flour in bakery products. Sample A2 (coconut flour cake) and Sample A (all-purpose flour cake) showed moderate to low ratings, with coconut flour contributing positively to appearance but resulting in denser cakes, and all-purpose flour yielding a product with lower nutritional density and less favorable texture. Overall, this study emphasizes the importance of ingredient selection in both the sensory and nutritional qualities of cakes. The findings suggest that tigernut flour, with its appealing flavor and nutritional benefits, could serve as a highly effective alternative to traditional flours in cake formulations. Future research could explore further optimization of tigernut flour-based cakes to fully harness its potential in meeting consumer preferences and dietary needs.

VII. CONCLUSION

This study demonstrates that tigernut flour offers significant advantages in enhancing the sensory properties of bakery products, particularly in cakes. Sample A3 (tigernut flour cake) emerged as the top-performing cake in terms of overall acceptability, appearance, color, flavor, and mouthfeel, owing to tigernut flour's natural sweetness, rich flavor, and smooth texture, which align with findings from previous research (Akinmoladun et al., 2021; Olayinka et al., 2021). The high fiber and healthy fats in tigernut flour contributed to its excellent sensory profile, making it a highly acceptable option for consumers.

VIII. RECOMMENDATIONS

The following recommendations are suggested:

1. Manufacturers could consider using blends similar to oat flour in baked products to enhance sensory qualities and nutritional value.
2. Emphasizing the nutritional profile on product packaging, particularly for samples with higher protein and fat content like A1 (Oat flour), may attract health-conscious consumers and expand the market reach for such products.
3. It is also recommended to explore the impact of drying and processing techniques specifically on sensory qualities to avoid diminishing the

nutrient, understanding how these methods influence the attributes (aroma, aroma, texture and flavour) could provide valuable insights for improving product quality and customer satisfaction.

4. Additional studies should be conducted on other flour blends to optimize the sensory and nutritional qualities of cakes. Future research could also investigate the effects of these flour blends on shelf life and storage stability.

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