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Nutritional and Pasting Properties of Enriched High-Quality Bread from Sweet-Potato Flour Spiced with Ginger

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Abstract

The rising demand for functional and nutritionally enhanced baked products has driven increased research into composite flour technology. This study developed and evaluated high-quality composite flour and bread from sweet potato-wheat flour incorporated with ginger powder, aiming to enhance the nutritional, sensory, and physicochemical properties. Composite flours were prepared by substituting sweet potato flour at 0%, 5%, 10%, 15%, and 30% (WH100, WH95, WH90, WH85, and WH70, respectively) and incorporating 1% ginger powder. The flours were analysed for pasting properties using the Rapid Visco Analyzer, while the bread samples were analysed for proximate composition, pH, and sensory attributes using standard methods. Result showed that protein content was highest in WH100 (15.45%) but declined with an increase in sweet potato inclusion, whereas fibre content improved, reaching 1.27% in WH70. Carbohydrate content also increased, with WH70 recording the highest value (73.13%). pH values ranged from 6.61 in WH70 to 7.23 in WH90, indicating reduced acidity at moderate substitution levels. Pasting results showed that peak viscosity increased with sweet potato addition, highest in WH70 (1564 RVU), although higher substitution also led to greater breakdown viscosity, suggesting reduced paste stability. Sensory evaluation revealed that WH70 achieved the highest overall acceptability among composite breads, closely aligning with the control WH 100, while WH95–WH85 scored lower. These findings suggest that WH70, with sweet potato flour at 30% substitution, in combination with 1% ginger powder, can be incorporated into wheat-based bread to enhance fibre content and functional properties while maintaining desirable sensory quality.

Keywords: Functional Foods; Composite Flour; Ginger; Bread; Nutritional Enhancement.

1. Introduction

Bread is a food product made primarily of flour, water, salt, and yeasts. Bread flour is commonly made from wheat, but it can also be made from maize, rye, barley, rice, and non-grain plants. Wheat flour is the most important basic ingredient in bakery goods. Wheat flour is the primary ingredient in the majority of breads due to its unique viscoelastic properties that allow for gas retention and dough expansion during

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baking (Zhang *et al.,* 2024; Haixi *et al.,* 2025). Bread is high in nutrients such as macronutrients (carbohydrates, protein, and fat) and micronutrients (minerals and vitamins) that are essential for human health. The nutritional content of bread is dependent on its chemical composition and the baking processes employed (Mohammed *et al.,* 2008; Mesta-Corral *et al.,* 2024). Bread is typically made from wheat flour, but it can also be made from composite flour, such as a blend of wheat and non-wheat flours or entirely non-wheat flour (David, 1992; Dako *et al.,* 2016; Weerarathna & Wansapala, 2024). The use of composite flour in bread production benefits developing countries because it promotes high-yielding native plant species, increases nutritional values, and boosts domestic agriculture production (Jolaosho, 2010; Babarinsa *et al.,* 2025).

Composite flour refers to the combination of two or more types of flour with the aim of producing a novel product that is superior to the individual components in terms of properties, performance, or economy (Adeniji, 2013). Since the 1960s, mixed flours or blends have been scientifically described as composite flours, and are now commonly defined as mixtures of various flours with or without wheat (Engindeniz & Bolatova, 2021). The need for composite flour initially arose from the scarcity of wheat caused by climatic and economic fluctuations, as well as growing awareness of the adverse health effects of excessive wheat consumption (Chandra *et al.,* 2015). In regions where wheat cannot be cultivated adequately, alternative grains such as rice in South and East Asia, maize in Central and South America, millet and sorghum in Africa, and rye and oat in Northern Europe have been extensively adopted in bakery products (Weerarathna & Wansapala, 2024). More recently, declining wheat yields and inferior quality due to global climate change have further encouraged the use of cereals that thrive in warmer climates, particularly in Africa and Asia (Torbica *et al.,* 2021). Beyond availability, blending wheat with non-wheat flours provides both economic and nutritional advantages. Economically, composite flours reduce reliance on imported wheat, conserve foreign exchange, and promote local agriculture, thereby contributing to food security (Dapčević-Hadnađev *et al.,* 2022; Engindeniz & Bolatova, 2021). Their affordability also makes them accessible to low-income groups (Ginindza *et al.,* 2022). Nutritionally, composite flours generally offer a richer profile in proteins and vitamins compared to wheat alone, providing healthier options for individuals with malnutrition and diet-related health conditions (Engindeniz & Bolatova, 2021). In addition, the rising prevalence of coeliac disease and other gluten-associated disorders has stimulated demand for non-wheat flour-based products (Dapčević-Hadnađev *et al.,* 2022). Since each flour component contributes unique colour, texture, and nutritive properties, composite flours enhance the diversity and functional quality of baked goods (Engindeniz & Bolatova, 2021). Although extensive studies have been carried out on composite flours, the majority have focused on partial rather than complete substitution of wheat.

Technology and research advancements indicated that sweet potato composite flours can be processed into a variety of food products for a variety of purposes. Sweet potato composite flour has been used to make a variety of food products such as doughnuts, biscuits, cakes, breads, cookies, fried chips, ice cream, porridge, breakfast foods, and weaning foods (Truong and Ramesh, 2010; Dako *et al.,* 2016). Nutritionists recommend increasing dietary fiber consumption in the daily diet to improve health (Dako *et al.,* 2016). Sweet potatoes are low in protein but high in dietary fiber and carbohydrate content, so combining a high nutritive value sweet potato variety with wheat flour for bread production would be nutritionally advantageous (Mounike *et al.,* 2025). Sweet potatoes provide an important source of fiber in the human diet. As a result, the combination of wheat flour and sweet potato flour increases the fiber content of bread and may have a significant impact on human health (Anton, 2008; Mounike *et al.,* 2025).

Ginger (*Zingiber officinale*) is a perennial bulbous herb renowned for its diverse medicinal and culinary applications (Begum, 2024). Believed to have originated in Central Asia, Siberia, and the region west of the Himalayas, ginger has a rich history of cultivation and use. Its presence in England dates back to before 1540, and today, it is extensively cultivated across the globe (Tyagi *et al.,* 2013). Ginger is one of the world's most popular spices, it is grown in about 300 different varieties around the world, mostly in hot and dry climates (Shakir & Ajdar, 2025).

Ginger's significance extends beyond its role as a popular food ingredient for flavour and spice. It contains primarily proteins and carbohydrates, most notably inulin, which has a prebiotic effect. Furthermore, ginger has antiseptic, anti-inflammatory, bactericidal, antiviral, antifungal, antiparasitic, and hypocholesterolemic activity, which is provided by a bioactive sulphur compound known as allicin (Luengo, 2007; Keservani *et al.,* 2024). In order to provide functional nutrients, Suleria *et al.,* (2015) created breads containing aqueous ginger extracts. They discovered that the bread's volume increased and the baking quality was impacted. Incorporating ginger oil microcapsules (GOM) into bread has been the subject of research by several writers (Narsaiah *et al.,* 2019).

There is a wealth of data available on various dough formulations and the quality of their bread loaves (Lazaridou *et al.,* 2007; Shittu *et al.,* 2007; Ziobro *et al.,* 2013; Verbeke *et al.,* 2024). However, limited attention has been given to the incorporation of functional ingredients such as ginger powder into sweet potato–wheat composite bread. Sweet potato flour offers the advantage of being locally available, rich in carbohydrates, fibre, and micronutrients, while also reducing reliance on imported wheat. Ginger, on the other hand, is known for its antioxidant, antimicrobial, and flavour-enhancing properties, which can contribute both to health benefits and improved product acceptability. Combining these ingredients with wheat flour has the potential to produce nutritionally superior bread with functional value and consumer appeal. Therefore, this study was undertaken to develop and evaluate sweet potato–wheat composite bread enriched with ginger powder, with the aim of improving its nutritional quality, sensory properties, and overall functionality.

2. Materials and Methods

2.1. Raw material collection and Preparation

The raw materials (sweet potatoes, wheat grains, ginger, salt, sugar, butter, and yeast) were purchased from Mile 12 market in Lagos State, Nigeria. High-quality wheat kernels were thoroughly cleaned and conditioned to remove impurities and improve milling efficiency. The conditioned kernels were then milled using a disc attrition machine to obtain finely ground wheat flour suitable for composite flour formulation. Sweet potato tubers were peeled, washed, and diced into uniform slices of approximately 5 mm thickness. A brief blanching step was carried out by immersing the slices in hot water at 70 °C for 10 minutes to inactivate enzymes that could cause undesirable colour changes and flavour degradation during drying. The blanched pieces were drained and spread evenly in a hot air oven maintained at 70 °C and dried until a constant weight was achieved. The dried sweet potato pieces were then milled using a disc attrition machine to obtain a fine flour consistency and sieved through a 1000 μm aperture size sieve to ensure uniform particle size suitable for flour formulation. Fresh ginger bulbs were cleaned, peeled, and minced. The minced ginger was uniformly spread onto drying trays in a hot air oven maintained at 60°C, and milled to a fine flour using a blender (Red Leaf GANGA, Model No 216395).

2.2. Formulation and Preparation of Bread

The bread formulation was developed based on the optimal sweet potato-wheat flour ratio and the selected concentration of ginger powder. High-quality baker's yeast and food-grade additives, including salt and sugar, were added to the flour blend to create well-rounded dough. The dough preparation involved a combination of mixing, kneading, and resting stages to develop proper gluten structure and improve dough elasticity. After the dough had undergone sufficient fermentation, it was divided, shaped into loaves, and placed in appropriately sized bread pans. The pans were then transferred to a controlled temperature proofing chamber, allowing the dough to rise and achieve the desired volume. Baking was carried out in a preheated oven under controlled conditions, ensuring uniform heat distribution for consistent baking outcomes.

Table 1: Composition of Flour Samples.

S/N	Sample	Wheat Flour (%)	Sweet Potato Flour (%)	Ginger (%)
1	WH100	100	___	___
2	WH95	95	4	1
3	WH90	90	9	1
4	WH85	85	14	1
5	WH70	70	29	1

2.3. Determination of the Properties of the flour samples

The proximate composition (moisture content, crude fiber, crude fat, total ash, crude protein and carbohydrate contents of the flour samples were determined as described by AOAC (2012). A moisture analyzer set at 103°C was used for moisture content determination. Samples were placed in the analyzer until a constant weight was obtained for each sample.

Ash content was determined using the AOAC (2012) method. Two grammes of the finely ground feed sample was weighed into a pre-weighed empty crucible. This was transferred into the muffle furnace set at 600°C and left for about 4 hours. The crucible and its content were cooled to room temperature in a desiccator. The crucible with the sample was weighed and the percentage ash content in the feed sample was calculated using the formula below:

$$\text{Ash } (\%) = (\text{Wt. of ash} / \text{Wt. of the sample taken}) \times 100. \qquad (1)$$

For protein content determination, one gramme of the grinded sample was weighed into a digestion flask and 1 Kjeldahl catalyst tablet was added, twelve (12) ml of conc. H_2SO_4 was added and digested for 2 hours in a (baker) fume hood with (Tecator 100l digester) until a clear solution was obtained. It was left until completely cool and then 100mls of distilled water was rapidly added. The digestion flask was rinsed twice and the rinse was added to a bulk. Markham distillation apparatus was used for distillation. The distillation apparatus was set up and add about 10 mls of the digest was added into the apparatus via a funnel and was allowed to boil. Ten mls of sodium hydroxide was added to the measuring cylinder so that ammonia is not lost. The mixture as distilled into 50 mls of two% boric acid containing screened methyl red indicator. The alkaline ammonium borate formed was then titrated directly with 0.1N HCL. The titer value which is the volume of acid used was recorded. The volume of acid used was fitted into the formula in equation (2) and % crude protein calculated using the formula in equation (3).

$$\%N = \frac{(14 \times VA \times 0.1) \times W \times 100}{1000 \times 100} \qquad (2)$$

VA= volume of acid used

W= weight of the sample

$$\%\text{Crude protein} = \%N \times 6.25 \qquad (3)$$

The fat content was determined using the method described by AOAC, (2012). Four gramme of dried sample was weighted into a fat-free thimble plugged lightly with cotton wool and extracted with n-hexane in Soxhlet apparatus set up for 5 hours. The residue extract was evaporated in an air oven at 100c for 30 minutes, cooled, and weighed. The fat content was calculated as follows:

$$\%\text{ fat} = \frac{(\text{weight of flask} + \text{fat}) - \text{weight of empty flask} \times 100}{\text{The original weight of the sample}} \qquad (4)$$

The crude fibre was determined according to the method described by AOAC, (2012). Two grammes of the sample was accurately weighed into a flask and 200ml of 1.25% H_2SO_4 was added. The mixture was heated under reflux for 30 minutes. The hot mixture was filtered through a fibre muslin cloth. The obtained filtrate was thrown off and the residue was returned to the fibre flask. 200ml of 1.25% NaOH was added into the and heated for another 30 minutes. The residue was removed and finally transferred into the crucible. The crucible and the residue were oven dried at 103°C overnight to drive off the moisture. The oven-dried crucible containing the residue was cooled in a desiccator and later weighed to obtain the W1. The crucible with W1 was transferred to the muffle furnace for ashing at 550°C for 4 hours. The crucible containing white or grey ash (Free of carbonaceous material) was cooled in the desiccator and weighed to obtain W2. The difference in W1 and W2 was the weight of fibre.

$$\%\text{fibre} = \frac{\text{W1} - \text{W2}}{\text{Original weight of the sample}} \text{ x } 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

W1 = Dried crucible + residue before ashing

W2 = Dried crucible + residue after ashing

The carbohydrate content in the samples was determined by difference. That is the values or percentages of moisture, ash, protein, fat and fibre was summed up and the value obtained was subtracted from hundred which gives the carbohydrate content (AOAC, 2012).

$$\text{Total carbohydrate} = 100 - (\text{Weight in grams [protein} + \text{fat} + \text{moisture} + \text{ash} + \text{fiber] in 100 g of sample}). \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

2.4. pH Analysis

A technique of (AOAC, 2012) was utilized to determine the pH (hydrogen ion concentration) in the goods, and a digital pH meter was employed. A portion of the 5 samples representing the flours of (WH 100, WH 95, WH 90, WH 85, WH 70) were placed in 5 separate beakers with distilled water and afterwards homogenized then readings of the pH scale of each sample is been taken accordingly three different times and recorded.

2.5. Pasting properties

Pasting parameters (pasting temperature, peak time, peak, trough, breakdown, final, and setback viscosities) of the flour samples were determined using a Rapid Visco Analyzer (Newport Scientific Pty Ltd) as described by Newport Scientific (1998). A 2.50 g of flour sample was weighed into a previously dried empty canister, and 25 ml of distilled water was dispensed into the canister containing the sample. The suspension was thoroughly mixed and the canister was fitted into the rapid visco analyzer. Each suspension was kept at 50% for 1 min, heated up to 95°C at 12.2 °C/min, and held for 2.5 min at 95°C. It was cooled to 50°C at 11.8°C/min and kept for 2 min at 50°C.

2.6. Sensory Analysis

In assessing the organoleptic characteristics of the coded samples of produced bread were served to an untrained panel of 30 judges consisting of students of the Mountain Top University, Ibafo, Ogun state. The panelists were educated on the respective descriptive terms of the sensory scales and requested to evaluate the cookies samples for taste, appearance, texture, aroma and overall acceptability using a 9-point Hedonic scale. Presentation of coded samples was done randomly and portable water was provided for rinsing of mouth in between the respective evaluations.

2.7. Statistical Analysis

Data were reported as averages of triplicate determinations and analyzed using Analysis of Variance (ANOVA). Duncan's multiple range test at a 5% level of significance was applied to determine significant differences among samples. The statistical package used was IBM SPSS Statistics version 21.

3. Results and Discussion

3.1 Proximate Composition of Samples

Moisture Content

Moisture content plays a vital role in the production of bakery goods, in which lower moisture content could provide a longer shelf life to the bread samples (Olalusi *et al.,* 2019; Oladunjoye *et al.,* 2021). The result obtained from the proximate analyses of the bread samples as illustrated in Table 2 shows no significant difference ($p< 0.05$). The moisture content of the flour samples ranges from 9.06 to 9.59. WH100 had the lowest moisture content although no significant difference was recorded among the values obtained. Sweet potato flour is hygroscopic in nature and has a high moisture binding capacity (Kang *et al.,* 2012). This result agrees with the report of (Ogundipe *et al.,* 2023) and is similar with the findings of (Olagunju *et al.,* 2020; Torbica, 2019) who reported that the moisture content of the composite bread increased with increasing non-wheat flour substitution.

Ash Content

The total ash content measures the total amount of minerals present in a food (Yin *et al.,*2023). The ash content of the bread samples ranges from 1.00 to 1.25%. There were no Significant ($p< 0.05$) differences among the obtained values. The results indicated that substituting wheat flour with sweet potato flour did not significantly alter the ash content of the blends, suggesting that the mineral composition of the composite flours remained relatively stable regardless of the substitution level.

Protein Content

The protein contents of the flour samples decreased significantly ($p< 0.05$) from 15.45% to 12.69% as sweet potato flour substitution in wheat flour increased (Table 2). WH70 displayed the lowest protein content of while WH100 showcased the highest protein content. However, the amount of protein present may not be enough to adequately prevent protein-energy malnutrition (Omosebi and Osundahunsi, 2021).

Crude Fibre Content

According to table 2, the crude fibre content of the flour samples ranged from 1.06% in WH100 to 1.27% in WH70, with WH70 recording the highest value. The increase in fibre content with higher substitution levels can be attributed to the fact that sweet potato flour contains more dietary fibre than wheat flour; hence, formulations with higher sweet potato inclusion contributed higher fibre. A significant difference was observed between 100% wheat flour and WH70. These values were higher than the fibre contents (0.83–1.11%) reported by Oyinloye et al. (2022) for wheat–potato composite flour. Dietary fibre in food products is known to promote beneficial physiological effects on health by improving satiety and bowel function (Sahin *et al.,* 2019). Thus, the inclusion of sweet potato flour has the potential to positively enhance the intake of healthier carbohydrates in staple foods such as bread.

Fat Content

The fat content analysis in this study showed significant differences ($p< 0.05$) among the various flour samples, with fat content ranging from 2.07 to 2.50%, (Table 2). WH70 had the lowest fat content while WH100 had the highest fat content with a general decrease in fat content of the flour with increased level of substitution of wheat flour with potato flour. Although this is contrary to the findings of Babarinsa *et al.,* (2025) who reported an increase in fat content with increased level of inclusion of potato flour.

Carbohydrate Content

There was a significant increase in carbohydrate content as the substitution level of sweet potato bread increased. The carbohydrate content was significantly different ($p< 0.05$) and it ranged from 70.68 to 73.13 % (Table 1). Similarity existed between WH70 and WH85. This value is in agreement with values reported by Oyinloye *et al.,* (2022) that substituted wheat flour with sweet potato flour in the production of bread.

Table 2: Proximate Composition of Composite Flour Samples

Sample	Moisture	Ash	Protein	Fibre	Fat	CHO
WH100	9.06±1.40a	1.25±0.25a	15.45±0.05a	1.06±0.03bc	2.50±0.87a	70.68±1.68b
WH95	9.76±0.12a	1.00±0.50a	15.15±0.10b	1.08±0.03c	2.30±1.32a	70.71±1.71b
WH90	9.59±0.24a	1.00±0.50a	14.22±0.20c	1.14±0.03b	2.17±0.29a	71.88±0.13b
WH85	9.30±5.73a	1.25±0.25a	13.02±0.21d	1.23±0.02a	2.10±0.87a	73.10±4.67a
WH70	9.59±0.33a	1.25±0.75a	12.69±0.11e	1.27±0.04a	2.07±0.29a	73.13±0.83a

Mean values with different superscript in the same column are significantly different at p<0.05

3.2. pH of flour Samples

The pH value is a measure a substance's acidity or alkalinity on a scale of 0 to 14. The pH of the bread samples was significantly different ($p < 0.05$) from each other, ranging from 6.61 - 7.23, the WH70 had the lowest pH of 6.61, and the WH90 had the highest pH of 7.23 as shown in Table 3.

Table 3: pH of flour samples

Samples	pH
WH100	6.70±0.37b
WH95	6.98±0.04bc
WH90	7.23±0.20a
WH85	7.09±0.10bc
WH70	6.61±0.37b

Mean values with different superscript in the same column are significantly different at p<0.05

3.3. Pasting Properties

Pasting properties are crucial in the determination of how flour behaves when heated in water. It affects the flour's texture, digestibility, and functionality (Ocheme *et al.*, 2018). This study determined the pasting profiles of wheat-potato composite flours to evaluate their suitability for conventional bread. The pasting properties of the wheat–potato flour blends are illustrated in Table 4. Except for the breakdown viscosity, the composite flours had significantly higher pasting parameters than the control (100% wheat flour). A higher peak viscosity, trough viscosity, final viscosity, and setback viscosity were also observed when potato flour was added to wheat flour. This agrees with the results of a study on the investigation of potato flour processing methods for noodles production (Buzera *et al.*, 2024). The viscosity of potato starch is higher than that of starch from cereal grains, such as wheat, rice, and corn (Waterschoot *et al.*, 2015).

Peak viscosity reflects the ability of starch granules to swell and absorb water. WH70 had the highest peak viscosity while WH100 had the lowest. This indicates that as the proportion of sweet potato flour increases, the flour mixture absorbs more water and swells more. Amylopectin is bound to phosphate groups in potato starch, resulting in the starch's high swelling power (Waterschoot *et al.*, 2015). Final viscosity indicates the ability of starches to form a gel upon cooling (Ashongbon & Akintayo 2012). WH70 had the highest final viscosity, meaning a firmer texture after cooling. High final viscosities have been attributed to amylose aggregation, while low final viscosities indicate a paste's ability to resist shear stress during stirring, as reported by (Liu *et al.*, 2021). Setback viscosity reflects the starch's tendency to retrograde (Balet *et al.*, 2019). WH70 had the highest setback viscosity, while WH100 had the lowest. The higher setback in WH70 suggests that increasing sweet potato flour leads to faster retrogradation, meaning the bread firmed up faster over time. This is due to the high amylose content in sweet potato starch. Pasting temperature is the minimum temperature at which starch begins to thicken. WH100 had the highest pasting temperature (89.10°C), while WH85 had the lowest (86.85°C). The inclusion of sweet potato flour lowers the pasting temperature, making the flour easier to cook. This means products made with sweet potato flour may require less energy for cooking, which is advantageous in food product development and processing.

Table 4: Pasting Properties of the flour Samples

Samples	Peak Viscosity (RVU)	Through Viscosity (RVU)	Breakdown Viscosity (RVU)	Final Viscosity (RVU)	Setback Viscosity (RVU)	Peak Time (Min)	Pasting Temperature (°C)
WH100	1278	1120	158	1404	284	6.60	89.10
WH95	1355	1219	136	1502	283	6.67	87.60
WH90	1344	1218	126	1511	293	6.73	87.00
WH85	1470	1300	170	1737	437	6.47	86.85
WH70	1564	1233	331	1923	690	5.80	86.90

3.4. Sensory Evaluation of Bread Samples

Table 5 shows the results of the sensory evaluation on the bread samples. The appearance of WH100, WH95 was significantly different ranging from 8.15 to 7.15. WH100 and WH95 have the highest appearance. This could be attributed to the natural colour of whole wheat. On the other hand, there was no significant difference ($p<0.05$) between the appearance of WH90, and WH85. The WH70 had the lowest appearance.

The texture of the bread samples was significantly different ($p<0.05$), ranging from 7.90 to 6.60. However, the results of WH90, WH85 and WH70 were similar. According to (Lu and Gao, 2011) gluten, which is highly elastic and extensible, can retain CO_2 from dough fermentation so that baking bread is porous and soft is high in wheat flour. However, protein from sweet potato flour is of high nutritional value, but has a low gluten level which is inadequate and may reduce bread volume and texture.

The aroma of the bread samples was significantly different ($p<0.05$), ranging from 8.30 to 6.00. This suggests that WH100 was rated higher in terms of aroma. On the other hand, the results for WH95, WH90, WH85 and WH70 were similar. This variation may be attributed to the presence of flavonoids and aromatic compounds in sweet potato, as well as the contribution of volatile compounds from the incorporated ginger powder, which imparts a characteristic spiciness (Oyinloye *et al.*, 2022; Dalsasso *et al.*, 2022).

The taste of the bread samples was significantly different ($p<0.05$) from each other ranging from 8.70 to 7.30. The WH70 was rated higher in taste compared to others. The overall acceptability of the bread samples was significantly different ($p<0.05$) from each other ranging from 8.75 to 5.95. It was observed that bread substituted with 70% sweet potato was best preferred in all the sensory attributes evaluated.

Table 5: Sensory attributes of bread sample

Sample	Appearance	Texture	Aroma	Taste	Overall acceptability
WH100	8.15±0.93^{a}	7.90±1.37^{a}	8.30±0.98^{a}	8.70±0.66^{a}	8.75±0.64^{a}
WH95	7.15±1.53^{ab}	6.60±2.04^{b}	6.85±1.39^{b}	5.15±1.98^{c}	5.95±2.11^{c}
WH90	6.90±1.68^{b}	7.20±1.70^{ab}	6.00±2.32^{b}	5.30±2.20^{c}	5.95±2.01^{c}
WH85	6.90±2.10^{b}	6.95±1.54^{ab}	6.20±2.09^{b}	5.35±2.11^{c}	6.35±1.90^{c}
WH70	7.00±2.00^{b}	7.25±1.71^{ab}	7.05±2.09^{b}	7.30±2.00^{b}	7.55±1.70^{b}

Mean values with different superscript in the same column are significantly different at p<0.05

4. Conclusions

In conclusion, the inclusion of sweet potato flour as a composite in bread-making significantly influenced the pasting properties, nutritional composition, and sensory characteristics of the flour and bread samples. Substituting wheat flour with up to 30% sweet potato flour, in combination with 1% ginger powder, enhanced the fibre content and carbohydrate composition while maintaining acceptable sensory qualities. WH70 (70% wheat, 30% sweet potato, 1% ginger) achieved the highest fibre content (1.27%) and recorded good overall consumer acceptability, closely aligning with the control (WH100). Beyond its nutritional contribution, the incorporation of ginger powder complemented the sensory profile through its characteristic spicy flavour and may have contributed functional bioactive compounds with antioxidant potential. This demonstrates that sweet potato–wheat composite bread enriched with ginger powder can improve dietary fibre intake, functional properties, and sensory appeal without compromising quality. Therefore, this study confirms that sweet potato–wheat composite flour with ginger powder is a viable alternative for developing nutritionally enhanced bread that supports dietary diversity and better health outcomes.

Conflict of interest: The authors declare that they do not have any conflict of interest.

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