



**INTERNATIONAL JOURNAL OF SCIENCE FOR GLOBAL SUSTAINABILITY**  
**Nutritional and Sensory Quality Attributes of Bread Produced from**  
**Wheat-Sprouted Finger Millet Flour**

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Received on: April, 2023

Revised and Accepted on: May, 2023

Published on: July, 2023

**ABSTRACT**

The current study was conducted to investigate the nutritional and sensory quality of wheat flour supplemented with sprouted finger millet flour in varying ratio to produce bread. Phytochemical screening of the ethanol extract of the flour samples confirmed the presence of many phytochemicals including flavonoids, phenols, terpenoids, alkaloids and tannins. The results of flavonoid, phenolic and alkaloid content of white wheat flour (WWF) are  $1.34 \pm 0.05$  (mg QE/g),  $2.25 \pm 0.05$  (mg GAE/g) and  $1.26 \pm 0.01$  (%) respectively. The mean concentration of raw finger millet flour (RFF) : sprouted finger millet flour (SFF) for flavonoid, phenolic and alkaloid are  $2.15 \pm 0.15$  mg QE/g :  $2.87 \pm 0.05$  mg QE/,  $4.24 \pm 0.04$  mg GAE/g :  $5.10 \pm 0.11$  mg GAE/g and  $2.56 \pm 0.03$  (%) :  $2.58 \pm 0.05$  (%). The results of moisture content, ash and carbohydrate of the bread increases from 8.28-10.18 %, 1.70-2.55 %, and 69.30-70.21 % while crude protein, crude fat and crude fiber of the bread decreases from 12.80-11.20 %, 3.62-2.01 %, and 4.30-3.90 %. The sensory score results revealed that bread made with 100 % WWF (sample A) was most acceptable. The study has revealed that acceptable nutrient dense bread can be made from wheat and sprouted finger millet flour up to 30 % substitution.

**Keyword:** Bread, Wheat flour, Finger millet, Nutritional evaluation, Sensory.

## 1.0 INTRODUCTION

Bread, a popular snack consumed globally across all age groups, is usually produced by a mixture of white flour, yeast, sugar, fat, salt, water, and optional additives. The mixture goes through a series of steps, including mixing, kneading, fermentation, proofing, and baking, as outlined by Gray (2023). White flour, which is the primary ingredient, is derived by eliminating the bran and germ components from the wheat kernel, resulting in solely the starchy endosperm. The resulting flour is known as white or refined flour, and bread made from it is referred to as white bread. White flour is an abundant source of carbohydrates, protein, and energy. While wheat flour is traditionally used for making bread, other cereal flours such as, barley, rye sorghum, millet and Maize has also been utilized independently or in conjunction with wheat flour for bread making in different segment of the

globe. The inclusion of wholegrain cereals in food formulations is experiencing a global surge in popularity, primarily due to their abundant phytochemicals and dietary fiber content. These components provide numerous health benefits, contributing to a positive impact on overall well-being, as pointed out by Rawat et al. (2023). Finger millet, scientifically referred to as *Eleusine coracana* L, this cereal grain is diminutive in size. Finger millet, a staple food, demonstrates vigorous growth and productivity, flourishing in semi-arid subtropical and tropical regions of Africa and Asia (Krishna, 2020). It is an incredibly nutrient-rich and wholesome cereal that is abundant in protein and minerals, (Wafula et al., 2018). Because of its easily digestible nutritional components, it serves as a vital food source for pregnant women, individuals with illnesses, nursing mothers, children, and those with diabetes (Tracyline et al.,

2021). Millets are devoid of gluten, establishing them as an exceptional alternative, for celiac patients (Selladurai et al., 2022). Foods containing high levels of phenolic acids, such as finger millet, have the potential to enhance diets and provide beneficial properties such as antioxidants, antiglycemic effects, and antimutagenic properties. This can lead to the creation of nutritious and wholesome food options (Kumar et al., 2021). Sprouting is an encouraging method to improve the value of composite wheat bread (Calvin, 2022). However, the production of nutrient-dense bread by supplementing wheat with sprouted finger millet has not been entirely explored. Hence, this study seeks to examine the nutritional and sensory evaluation of bread produced from wheat augmented with sprouted finger millet flour. By harnessing the nutraceutical and functional capabilities of sprouted finger millet, the aim is to develop nutritious intervention snacks like bread.

## 2.0 MATERIAL AND METHOD

### 2.1 Sample Collection

The finger millet grains were sourced from the experimental farm at Ahmadu Bello University in Zaria, while commercially available wheat flour was procured from a marketplace in Osogbo., Osun State, Nigeria. Finger millet grains underwent a cleaning process to remove foreign matters such as dust particles, seeds of other grains/crops, and other impurities such as stones and weeds. It was split into two equal portions/parts. One part of the grains was pulverized and sieved to obtain fine powder for the control sample. The wheat flour was used as purchased without any further modification. The flour samples were packaged using high-density polyethylene material for further analytical works.

### 2.2 Sprouting of Finger Millet Grains

The sprouting of finger millet followed the methodology outlined by Syed et al. (2011). The

seeds were immersed in water-filled glass containers and left to soak for 24 hours at room temperature. Once soaked, the seeds were carefully taken out of the glass containers and any excess moisture was eliminated by rolling them gently on a thick absorbent cloth. The previously soaked seeds were placed on sterile germinating trays covered with filter paper, ensuring a moist environment by layering damp cotton wool. The seeds were allowed to sprout at a constant room temperature of  $28 \pm 1$  °C for a duration of 96 hours. Following the sprouting period, the seeds were dried using a cabinet dryer set at 45 °C for 12 hours. Subsequently, the germinated seeds were ground, sieved, and carefully packed into polyethylene bags for future analysis.

### 2.3 Preparation of Wheat and Finger Millet Flour Extracts

Approximately 100 g of each flour sample was extracted through maceration using 70% ethanol, with a ratio of 1:7 for sample to solvent. The mixture was vigorously shaken and left to settle for 48 hours at room temperature. Subsequently, the mixture underwent filtration using a Whatman No.1 filter paper, separating the filtrate from the residue. The residue was then subjected to three additional rounds of maceration, each time with an equal volume of ethanol, for 24 hours. This process was repeated to ensure a sufficient quantity of extract was obtained. The obtained filtrates from each maceration cycle were combined, and the solvent was evaporated to dryness using an Eyela N-1001 vacuum rotary evaporator at approximately 40 °C.

### 2.4 Formulation of Flour Blends

Table 1 shows the formulation of various blends of sprouted finger millet and wheat flours together with other constituents used in the bread production

**Table 1: Formulation of ingredient for the production of bread**

WF (%)	SFF (%)	Yeast (g)	Margarine (g)	Vanilla (g)	Water (mL)	Salt (g)	Sugar (g)	Bread Improver (g)
100	0.00	3.00	1.00	1.00	56.00	1.00	6.00	0.20
90	10.00	3.00	1.00	1.00	56.00	1.0	6.0	0.20

80	20.00	3.00	1.00	1.00	56.00	1.0	6.0	0.20
70	30.00	3.00	1.00	1.00	56.00	1.0	6.0	0.20
60	40.00	3.00	1.00	1.00	53.00	1.0	6.0	0.20
50	50.00	3.00	1.00	1.00	51.00	1.0	6.0	0.20

WF = White Wheat flour, SFF = Sprouted finger millet flour

## 2.5 Production of Bread

The white wheat flour was mixed with sprouted finger millet flour. The composite flours were combined with additional baking ingredients in a mixer, and then kneaded for a duration of 12 minutes until a uniform dough was formed. The resulting dough was shaped and placed in a baking bowl that had been pre-greased with oil. All ingredients were mixed in a Kenwood mixer (Model A 907D). The dough was allowed to undergo proofing for a period of 45 to 60 minutes at a temperature of 35 °C. Subsequently, it was oven baked at 217 °C for duration of 35 minutes.

## 2.6 Phytochemical, Nutritional and Sensory Analysis of Flours and Bread

### 2.6.1 Phytochemical Screening

**Test for Terpenoids:** The flour extract was combined with 2 mL of chloroform in a 5 mL volume, and concentrated H<sub>2</sub>SO<sub>4</sub> was subsequently introduced to create a distinct layer. The confirmation of terpenoid presence was evidenced by the formation of a reddish-brown coloration at the interface, as reported by Sivaraj, Balakrishnan, Thenmozhi, and Venckatesh (2011) and Pawaskar and Kale (2007).

**Test for Steroids and Phytosterols:** To each sample's 0.5 mL of flour extract, 2 mL of H<sub>2</sub>SO<sub>4</sub> was added along with 2 mL of acetic anhydride. The presence of steroids and sterols was indicated by a color transformation from violet to blue-green in the sample (Sivaraj *et al.*, 2011, Pawaskar and Kale, 2007).

**Test for Tannins:** In a test tube, 0.5 mL of the flour extract was heated in 20 mL of water, followed by filtration. A few drops of 0.1% ferric chloride were then introduced, and the mixture was observed for the appearance of a brownish-green or blue-black

coloration, as described in Trease and Evans (1989). The presence of Gallic tannins was indicated by a blue color, while the presence of Catecholic tannins was indicated by a green-black color (Pawaskar and Kale, 2007; Sivaraj *et al.*, 2011).

**Test for Alkaloids:** 1.5 mL of 1% HCl was added to 2 mL of flour extract. The solution was heated in a water bath for a few minutes. Following that, 6 drops of Wagner's reagent were introduced. The presence of alkaloids was confirmed by the formation of an orange precipitate. (Oguyemi, 1979; Pawaskar and Kale, 2007; Venkatesan and Palani, 2009).

**Test for Cardiac Glycosides:** The flour extract (5 mL) was combined with glacial acetic acid (2 mL) containing a single drop of ferric chloride solution. The mixture was then layered with concentrated sulphuric acid (1 mL) underneath. The presence of a brown ring at the interface indicated the presence of a deoxy sugar, which is characteristic of cardio glycosides. Below the brown ring, a violet ring may appear, and throughout the thin layer in the acetic acid, a gradual formation of a greenish ring may be observed. (Finar, 1983; Pawaskar and Kale, 2007; Sivaraj *et al.*, 2011).

**Test for Saponins:** The flour extract (5 mL) was heated by boiling it in 5 mL of distilled water using a water bath, followed by filtration. A portion of the filtrate (10 mL) was combined with 5 mL of distilled water and vigorously shaken to create a stable and persistent froth. The frothy mixture was then mixed with 3 drops of olive oil and vigorously shaken again, after which it was viewed for the formation of an emulsion (Pawaskar and Kale, 2007; Sivaraj *et al.*, 2011).

**Test for Phenols:** 2 mL of the flour extract was combined with 1 mL of a 1% ferric chloride solution. The presence of phenols was determined

by observing a blue or green coloration in the mixture.

**Test for Flavonoids:** A portion of the flour extract was heated individually with 10 mL of ethyl acetate in a water bath for 3 minutes. The resulting mixture was filtered, and 4 mL of each filtrate were vigorously shaken with 1 mL of dilute ammonia solution. The presence of flavonoids, as described by Harborne (1973) and Pawaskar and Kale (2007), was confirmed by the appearance of a yellow color.

**Test for reducing sugars:** 2 mL of crude flour extract was mixed with 5 mL of distilled water and then filtered. The resulting filtrate was boiled with an excess amount (1-2 mL) of Fehling's solution A and Fehling's solution B, along with 3-4 drops of each, for a duration of 2 minutes. The presence of reducing sugars, as indicated by Pawaskar and Kale (2007) and Venkatesan et al. (2009), was confirmed by the formation of an orange-red precipitate.

## 2.6.2 Quantitative Phytochemical Analysis

### 2.6.2.1 Flavonoid Content

The flavonoid content of the flour samples was determined using the spectrophotometric method developed by Dewanto et al. (2002), with Quercetin as the standard substance. A 1 mL portion of the sample, prepared in ethanol at a concentration of 100 µg/mL, was combined with 4 mL of distilled water in a 10 mL volumetric flask. Thereafter, 0.3 mL of a 5% NaNO<sub>2</sub> solution was added to the flask. After a 5-minute incubation period, 0.3 mL of a 10% AlCl<sub>3</sub> solution was introduced, followed by the addition of 2 mL of 1.0 M NaOH at the 6th minute. After supplementing the reaction flask with 2.4 mL of distilled water and thoroughly shaking it, the absorbance of the resulting reaction mixture was measured at 510 nm using a spectrophotometer (JENWAY 6305, Staffordshire, UK). A reagent blank was prepared simultaneously by using 1 mL of methanol instead of the extract, and it was treated in the same manner as the samples. To establish a calibration curve, the same procedure was repeated using standard solutions of Quercetin ranging from 2 to 10 µg/mL, resulting in a coefficient of determination (R<sup>2</sup>) of 0.986. The total flavonoid content of the samples was estimated by correlating the measured absorbance values with the Quercetin

calibration curve. The results were expressed as milligrams of Quercetin Equivalent per gram (mg QE/g) of the sample on a dry weight basis. The test was conducted in triplicate to ensure accuracy and reproducibility.

### 2.6.2.2 Phenolic Content

The total phenolic content of the sample was determined using the method outlined by Singleton et al. (1999). The principle of this assay relies on the reduction of the Folin-Ciocalteu reagent, comprising phosphomolybdate and phosphotungstate, by the phenolic compounds found in the extract. The reaction mixture was prepared by combining 0.5 mL of an ethanol solution of the sample, which contained 100 µg/mL, with 2.5 mL of a 10% aqueous solution of Folin-Ciocalteu reagent and 2.5 mL of a 7.5% NaHCO<sub>3</sub> solution. Simultaneously, a blank solution was prepared by mixing 0.5 mL of ethanol, 2.5 mL of a 10% aqueous solution of Folin-Ciocalteu reagent, and 2.5 mL of NaHCO<sub>3</sub> solution. The sample was subjected to incubation in a Uniscope SM801A laboratory water bath, maintained at a temperature of 45 °C, for a duration of 45 minutes. Following the incubation period, the absorbance of the sample was measured using a spectrophotometer (JENWAY 6305, Staffordshire, UK) at a wavelength of 765 nm. To establish a standard calibration curve, standard solutions of gallic acid underwent the same incubation procedure, and their respective absorbance values were recorded. These absorbance values were then utilized to construct the standard calibration curve. The phenolic content of the sample was estimated by extrapolating its measured absorbance values from the standard calibration curve. The phenolic content was subsequently expressed as gallic acid equivalent (mg GAE/g) per gram of the sample. To ensure accuracy and reliability, each sample was subjected to analysis in triplicate.

### 2.6.2.3 Determination of alkaloid

The method of Harborne (1973) was used to analyse alkaloid content. A 250 mL beaker was used to weigh five grams (5 g) of the sample. Subsequently, 200 mL of a 10% acetic acid in ethanol solution was added to the beaker, and the mixture was allowed to stand undisturbed for a duration of 4 minutes.

The mixture was then filtered, and the resulting extract was concentrated on a water bath until its volume was reduced to one-quarter of the original volume. Dropwise addition of concentrated ammonium hydroxide continued until precipitation was complete. The entire solution was then allowed to settle, and the resulting precipitate was collected. The precipitate was washed with dilute ammonium hydroxide and subsequently filtered. The collected precipitate was dried and weighed. The difference in weight before and after drying was determined, and this weight difference was considered as the percentage of alkaloid found in the sample.

### 2.6.3 Proximate analysis

The moisture, ash, crude fiber, protein (N\*6.25), crude fat, and carbohydrate content were assessed in the samples using the AOAC (2005) method. The carbohydrate content was determined by the difference method.

### 2.7 Sensory Evaluation of Bread

A sensory evaluation was conducted in the sensory laboratory, involving 40 panelists. Each panelist was given bread samples made from various flour blends. To cleanse their palate between samples, water was provided. The panelists were instructed to assess the color, flavor, taste, texture, and overall acceptance of the bread using a 9-point hedonic scale, ranging from 1 (dislike extremely) to 9 (like extremely).

### 2.8 Statistical Analysis

The experimental results were analyzed using analysis of variance (ANOVA), and the means were compared using Duncan's multiple range test to determine significant differences ( $p < 0.05$ ) among the samples.

## 3.0 RESULTS AND DISCUSSION

**Table 2: Phytochemical Screening of White Flour, Unsprouted and Sprouted Finger Millet**

Phytochemicals	Test	White flour	Unsprouted finger millet flour	Sprouted finger millet flour
Terpenoids	Chloroform and H <sub>2</sub> SO <sub>4</sub>	+	+	+
Steroids and phytosterols	Acetic anhydride and H <sub>2</sub> SO <sub>4</sub>	-	-	+
Tannins	Ferric chloride test	-	+	+
Alkaloids	Wagner's test	+	+	+
Cardiac glycosides	Keller-Killani Test	-	-	-
Phenols	Ferric chloride test	+	+	+
Flavonoids	With ammonia solution	+	+	+
Reducing sugar	Fehling's Test	+	+	+

+ = present, - = absent

### 3.1 Phytochemical screening of White Wheat flour, Unsprouted and Sprouted Finger Millet

Table 2 showed the result of the phytochemical screening of white wheat and finger millet flour.. White wheat flour showed the presence of terpenoids, alkaloids, phenol, flavonoid, and

reducing sugar while steroids/ phytosterols, tannins, and cardiac glycosides were absent. Raw finger millet showed the presence of terpenoids, alkaloids, tannins, phenol, flavonoid, and reducing sugar while steroids and cardiac glycosides were absent in it. Sprouted finger millet contains all the phytochemicals tested except cardiac glycosides.

These phytochemicals have been known to display certain biological activities such as antioxidant, antimicrobial activities, anti-inflammatory, and antiplasmodial (Zongo et al., 2023). Steroids cause the disruption of the lipid-bilayer membrane, leading to the release of liposomes (Crowley et al.,

2022), Enzymatic proteins are liberated by saponins originating from microbial cells (Kholif., 2023) while terpenoids participate in the degradation of cell walls and tissues in microorganisms, leading to their weakening. (Huang et al., 2022).

**Table 3: Phytochemical Analysis of White Wheat flour, Raw and Sprouted Finger millet**

Phytochemical	WWF	RFF	SFF
Flavonoid (mgQE/g)	1.34 ± 0.05	2.15 ± 0.15	2.87 ± 0.05
Phenolic (mgGAE/g)	2.25 ± 0.05	4.24 ± 0.04	5.10 ± 0.11
Alkaloid (%)	1.26 ± 0.01	2.56 ± 0.03	2.58 ± 0.05

RFF – Raw Finger Millet flour, WWF= White Wheat Flour, SFF= Sprouted Finger Millet flour

### 3.2 Phytochemical Analysis of White Wheat flour, Raw and Sprouted Finger millet Flour

The result of the quantitative phytochemical analysis of the white flour, raw, and sprouted finger millet are presented in Table 3. The results showed that the flavonoid, phenolic, and alkaloid contents of WWF were 1.34 ± 0.05 (mg QE/g), 2.25 ± 0.05 (mg GAE/g) and 1.26 ± 0.01 (%) while that of RFF were 2.15 ± 0.15 mg QE/g, 4.24 ± 0.04 mg GAE/g and 2.56 ± 0.03 %, respectively. Also, the flavonoid, phenolic and alkaloid contents SFF were 2.87 ± 0.05 mg QE/g, 5.10 ± 0.11 mg GAE/g, and: 2.58 ± 0.05 %, respectively. The result showed an increase in the contents of flavonoid, phenolic, and

alkaloid after the sprouting of finger millet. Numerous investigations conducted on cereal grains have demonstrated that the sprouting process has the potential to enhance the amount of solvent-extractable phenolic compounds. Numerous authors have proposed that the rise in water-soluble polyphenolic compounds during the sprouting process can be attributed to both de novo synthesis and transformation. (Benincasa, 2019). This is in agreement with the findings of Zuzana et al. (2016) who observed an increase in the flavonoid content during the germination of lentils from 3.4 mg - 34.8 mg.

**Table 4: Proximate Composition of Bread produced from White Wheat and Sprouted finger millet flours**

Sample	Moisture content (%)	Crude Protein (%)	Crude Fat (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
A	8.28±1.00 <sup>a</sup>	12.80±1.00 <sup>f</sup>	3.62±1.00 <sup>f</sup>	1.70±1.00 <sup>a</sup>	4.30±1.00 <sup>f</sup>	69.30±1.00 <sup>a</sup>
B	8.64±1.00 <sup>b</sup>	12.47±1.00 <sup>e</sup>	3.35±1.00 <sup>e</sup>	1.87±1.00 <sup>b</sup>	4.22±1.00 <sup>e</sup>	69.45±1.00 <sup>b</sup>
C	9.03±1.00 <sup>c</sup>	12.17±1.00 <sup>d</sup>	3.08±1.00 <sup>d</sup>	2.04±1.00 <sup>c</sup>	4.08±1.00 <sup>d</sup>	69.60±1.00 <sup>c</sup>
D	9.27±1.00 <sup>d</sup>	11.81±1.00 <sup>c</sup>	2.86±1.00 <sup>c</sup>	2.25±1.00 <sup>d</sup>	4.06±1.00 <sup>c</sup>	69.75±1.00 <sup>d</sup>
E	9.72±1.00 <sup>e</sup>	11.28±1.00 <sup>b</sup>	2.54±1.00 <sup>b</sup>	2.35±1.00 <sup>e</sup>	3.94±1.00 <sup>b</sup>	70.21±1.00 <sup>e</sup>
F	10.18±1.00 <sup>f</sup>	11.22±1.00 <sup>a</sup>	2.01±1.00 <sup>a</sup>	2.55±1.00 <sup>e</sup>	3.90±1.00 <sup>a</sup>	70.14±1.00 <sup>e</sup>

Mean values followed by the same letter (s) within the same column are not significant (p ≥ 0.05).

Legend: A =100WWF, B = 90% WWF, 10% SFF, C =80% WWF, 20%SFF, D=70% WWF, 30%SFF, E =60% WWF, 40% SFF, F =50% WWF, 50% SFF

WWF= White Wheat Flour, SFF= Sprouted Finger Millet flour

### 3.3 Proximate Composition of Bread Produced from White Wheat and Sprouted Finger Millet flour

Table 4 displays the proximate composition analysis results of bread made from blends of wheat and finger millet flour. As the proportion of finger millet flour increased from 0% to 50%, the

moisture content of the bread exhibited a notable increase. Conversely, the protein content of the bread demonstrated a significant decrease with higher levels of finger millet incorporation. Bread made with 100 % white wheat flour (sample A) had 8.28 % moisture, 12.80 % protein, 3.62 % fat, 1.70 % ash, 4.30 % crude fiber, and 69.30 %

carbohydrate. The rise in moisture content observed in the bread samples could be attributed to the elevated moisture content present in the sprouted finger millet grains. There was a decrease in the protein and fat content of the bread as the level of finger millet supplementation increased. This corroborates the findings of Ibrahim et al. (2021) who also reported decreased protein and fat contents of the bread produced as the level of sprouted finger millet substitution increased. The decrease in the content of protein of the bread sample may be attributed to the low protein content of the sprouted finger millet grains. However, there was a significant increase in ash and carbohydrate contents of the bread samples with increasing levels of sprouted finger millet flour. Sample F exhibits

the highest ash content (2.55%) among all samples, whereas sample E displays the highest carbohydrate content (70.21%). The elevated ash content might be attributed to the abundant ash content found in the sprouted finger millet. The increase in ash content corresponds to an increase in the mineral contents of the bread which is pivotal in the regulation of body processes. A similar result was reported by Mounika and Sireesha (2021). The increase in carbohydrates could be associated to the high carbohydrate content of sprouted finger millet flour and wheat flour. The decrease observed in fat and crude fiber contents of the bread with increasing levels of sprouted finger millet supplementation could be associated to the low fat and crude fiber in the sprouted finger millet

**Table 5: Sensory characteristics of bread made from white wheat flour and sprouted finger millet**

Sample	Crust colour	Crumb colour	Taste	Texture	Flavour	Overall acceptability
A	6.67±0.24 <sup>d</sup>	7.00±1.00 <sup>d</sup>	6.33±0.36 <sup>c</sup>	6.00±0.81 <sup>cd</sup>	6.67±1.00 <sup>d</sup>	7.00±0.81 <sup>c</sup>
B	6.00±1.00 <sup>c</sup>	6.00±0.27 <sup>b</sup>	6.00±0.88 <sup>ab</sup>	6.33±0.33 <sup>c</sup>	6.00±1.00 <sup>c</sup>	6.00±0.81 <sup>b</sup>
C	6.00±1.00 <sup>c</sup>	5.97 ±0.27 <sup>b</sup>	5.33±0.08 <sup>ab</sup>	6.00±0.81 <sup>cd</sup>	6.00±1.00 <sup>c</sup>	6.33±0.81 <sup>bc</sup>
D	7.00±0.24 <sup>d</sup>	5.33±0.33 <sup>bc</sup>	6.00±0.08 <sup>ab</sup>	6.67±0.81 <sup>d</sup>	6.00±1.00 <sup>c</sup>	6.67±0.81 <sup>bc</sup>
E	5.00±1.00 <sup>a</sup>	5.00±0.27 <sup>b</sup>	5.00±0.08 <sup>a</sup>	5.00±0.06 <sup>ab</sup>	4.33±1.00 <sup>b</sup>	4.67±0.07 <sup>a</sup>
F	4.33±1.00 <sup>b</sup>	4.00±1.00 <sup>a</sup>	4.67±0.08 <sup>a</sup>	4.33±0.06 <sup>a</sup>	3.33±1.00 <sup>a</sup>	4.00±0.07 <sup>a</sup>

Values bearing the same superscript within the same column are not significantly ( $p>0.05$ ) different from each other.

Legend: A =100WWF, B = 90% WWF, 10% SFF, C =80%WWF, 20%SFF, D=70%WWF, 30%SFF, E =60%WWF, 40% SFF, F =50% WWF, 50% SFF

WWF= White wheat flour, SFF= Sprouted finger millet flour

### 3.4 Sensory Characteristics of Bread made from White Wheat and Sprouted Finger millet flour

The sensory properties of composite bread samples produced from mixture of wheat and treated finger millet flour were presented in Table 5. The crust color score of the bread made with 30 % substituted finger millet flour was significantly higher than other samples except for the control sample A with 100 % wheat flour whereas there was no change in the crust color between 10 % and 20 % sprouted finger millet flour substitution. The crumb color score decreased from 6.00 - 4.00 as the level of sprouted finger millet increased. Significant difference ( $p<0.05$ ) was observed between the control sample and the treated samples. The decreased preference of the mean crumb color scores for composite breads at increasing germinated finger millet flour supplementation levels goes in line with the findings by Raid and

Klein (1983) who observed that, with an increase in the proportion of non-wheat flour in the blends, the crust color of the bread transitions from a creamy white to a dull brown or dark shade. The intensified crust color can be attributed to the dark-brown hue of the finger millet flour, as well as the heightened impact of the Maillard reaction between reducing sugars and amino acids in the protein. The control sample had the highest score (7.00) followed by 10 % finger millet substitution (6.00), while the 50% substitution had the lowest score (4.00). The 50 % finger millet substitution was neither liked nor disliked. The control sample had the highest score in terms of taste acceptability. Samples B, C, and D are not significantly different ( $p.0.05$ ) in their taste score. The bread taste of samples A, B, and C was liked very much. Also, there is no significant difference between the mean score taste of 40 %

and 50 % sprouted finger millet flour supplementation.

The sensory score for texture at the 30 % substitution level had the highest score (6.67); showing that the texture of the bread increased with up to 30 % sprouted finger millet flour substitution while at 50 % substitution, the texture score had the lowest score (4.33). The texture of bread decreased from 30 % to 50 % supplementation. The flavor of the 100 % wheat flour bread had the highest score (6.67), whereas no significant difference existed among 10, 20, and 30 % sprouted finger millet flour substitution.

#### 4.0 CONCLUSION

Sprouted finger millet was found to possess certain phytochemicals which have been said to have some antioxidant properties. Sprouting brought about an appreciable increase in the concentration of the phytochemical compounds analyzed. There was also an increase in the ash and carbohydrate content of the bread produced as the level of supplementation of wheat with finger millet increased. The increase in carbohydrate and ash content suggests that incorporating sprouted finger millet flour into wheat flour bread would result in a nutrient-rich and energy-dense food source suitable for individuals of all ages. For the sensory acceptability, sample A had the highest score which was closely followed by bread made with 30 % sprouted finger millet supplementation. This implies that wheat flour could be substituted with up to 30 % sprouted finger millet flour to prepare bread with acceptable sensory qualities.

**Conflict of interest:** The authors affirm that there are no conflicts of interest concerning the publication of this paper.

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