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RESEARCH ARTICLE

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Production and Quality Evaluation of Flour Produced From Two Varieties of Sweet Potato

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Abstract

This study investigated the production and quality evaluation of flour from two sweet potato varieties (cream-fleshed and purple-fleshed sweet potato) subjected to different processing treatments: blanching, sulphiting, and untreated as a control sample. The resulting flour samples were analyzed for functional, pasting, color, proximate, mineral, and vitamin properties using standard analytical methods. Significant differences (p<.05) were observed among the flour samples. Results of functional properties showed that the bulk density of sample SPSF (Sulphited purple fleshed sweet potato flour) had the lowest bulk density of 0.73 g/ml and the least gelation capacity of 6.00%. Sample SPSF (Sulphited purple fleshed sweet potato flour) recorded higher values in water absorption capacity (2.41 g/g), oil absorption capacity (1.72 g/g), and swelling capacity (5.70 %). Sample RFCS (Raw cream fleshed sweet potato flour) showed the least dispersibility of 69.15%. The results of the pasting properties showed that sample PSRF (Untreated purple-fleshed sweet potato flour) showed the highest peak viscosity (319 RVU), Trough viscosity (219.00 RVU), breakdown (100.00 RVU), and final viscosity (386.00 RVU), respectively. Sample SPSF (Sulphited purple-fleshed sweet potato flour) recorded the lowest setback (148.00 RVU). Color evaluation indicated higher lightness values in cream-fleshed sweet potato flour samples (86.42 – 89.76) compared to purple-fleshed samples (62.54 – 69.45). Moisture content ranged between 8.93 – 9.81%, with sample SPSF (Sulphited purple-fleshed sweet potato flour) recorded as the lowest, while carbohydrate content varied between 80.09 and 81.93%. Untreated purple-fleshed sweet potato flours generally exhibited higher protein, ash, fiber, and mineral contents for calcium (46.10 – 48.50 mg/100 g), potassium (319.20 – 350.50 mg/100 g), and phosphorus (58.30 – 62.50 mg/100 g). Furthermore, untreated purple-fleshed flour recorded the highest vitamin A (465.50 mg/100 g) and vitamin C (24.03 mg/100 g) contents. The study showed that both sweet potato varieties possess desirable nutritional and functional attributes, with purple-fleshed sweet potato flour, particularly the untreated sample, exhibiting superior nutritional quality. Therefore, sweet potato flour has considerable potential for application in food product development and nutritional enhancement of cereal-based foods.

Keywords: Sweet potato, flour, quality evaluation.

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INTRODUCTION

The sweet potato (SP), *Ipomoea batatas* L., is the second most important tuber crop globally and is harvested in over 110 countries. It is native to and domesticated in tropical America, between Mexico and Peru. Sweet potato is a globally important vegetable, ranking among the six most important food crops after rice, wheat, potato, corn, and manioc (Leonel et al., 2023). As reported by the Food and Agriculture Organization of the United Nations (FAO), its global production in 2022 reached 86.4 million tons, with Mexico contributing 81,095 tons (Ritchie et al., 2023). According to this report, China accounted for most of the global production at 53.9%, followed by Malawi (9.3%), Tanzania (4.9%), and Nigeria (4.6%). A diversity of varieties is observed, displaying a range of colors, including orange, red, purple, yellow, brown, cream, and white, and each variety possesses a distinct chemical and nutritional composition (Oloniyo et al., 2021). Among the types, purple sweet potato has the highest anthocyanin content. This is what causes the purple-black color. Purple sweet potato anthocyanin content ranges from 33.90 mg/100 g to 560 mg/100 g and acts as an antioxidant (Hossain et al., 2022). The anthocyanin content in purple sweet potato not only has the potential as a natural dye, but can also provide various nutraceutical properties such as free radical activity (Kindeya et al*.,* 2022). Sweet potatoes also contain high calcium, and their carbohydrate content is classified as having a Low Glycemic Index (LGI, 54), which means it is very suitable for diabetics. Sweet potato starch includes resistant starch, which helps the human body to remove cholesterol and prevent cancer (Neela & Fanta, 2019). Sweet potato composition includes carbohydrates, dietary fiber, vitamins, minerals, and several bioactive metabolites. The purple variety is characterized by its significant content of anthocyanins, while the yellow and orange varieties contain carotenoids and are dense in provitamin A (Tang et al., 2015). In addition to their high water-soluble dietary fiber content, sweet potato tips are also a rich source of protein when compared to other vegetables, as well as iron, potassium, vitamins B2, C, and E (Hong et al., 2022). The main carbohydrate of sweet potato is starch; however, the tubers also contain significant amounts of sucrose, glucose, and fructose, which are responsible for their sweet taste (Leonel et al., 2023). Also, during storage and cooking, the presence of maltose is observed due to the hydrolysis of starch by α- and β-amylases.

Sweet potato flour is gaining importance as a nutritious and functional ingredient, but its quality is highly affected by processing methods. These treatments are commonly used to reduce browning and improve shelf stability, yet they may also cause losses in nutrients, phytochemicals, and changes in functional and pasting properties. In addition, cream- and purple-fleshed sweet potato varieties differ in their nutritional and bioactive composition, but their responses to these processing methods are not fully understood. This creates a gap in knowledge on how to optimize processing conditions to produce high-quality flour with balanced nutritional and functional properties. The increasing demand for nutritious, affordable, and gluten-free flour alternatives has intensified interest in sweet potato flour as a functional ingredient in both household and industrial food formulations. However, its commercial viability depends largely on maintaining consistent quality during processing. However, this present study is necessary because sweet potato flour is increasingly used in food products, but its quality depends on processing conditions. Treatment (Blanching and sulphiting) may improve overall quality and also reduce some components while altering functional properties. Understanding these effects is important for improving nutritional retention; selecting suitable sweet potato varieties could enhance food functionality and support industrial application of sweet potato flour. However, this study will investigate the production and quality evaluation of flour from two sweet potato varieties (cream-fleshed and purple-fleshed sweet potato).

MATERIALS AND METHODS

Materials

Sources of materials: Cream-fleshed sweet potato was purchased from Owode market, while purple-fleshed sweet potato was procured from a local market, Gwari, Abuja. All the sweet potatoes purchased were transported to the Food Processing Laboratory, Food Technology Department, Federal Polytechnic Offa, Kwara State.

Methods

Production of Blanched Sweet Potato Flour

One (1) kg of sweet potato each (cream- and purple-fleshed) was washed carefully with tap water, cut into small pieces (about 1 cm), and blanched for 10 mins. The blanched sweet potato slices were dried with a mini dehydrator at a temperature of 60±5˚C until the absolute humidity was less than 14%. The dried tubers were ground using an electric blender for 5 mins, sifted using a sieve machine to pass a 250 µm sieve. The flours were packaged in a polyethylene bag and stored at ambient temperature for further analyses.

Production of Sulphited Sweet Potato Flour

One (1) kg of sweet potato each (cream- and purple-fleshed) was washed carefully with tap water, cut into small pieces (about 1 cm) and placed in 0.2% sodium metabisulfite solution for 30 mins. The sulphited sweet potato slices were dried with a mini dehydrator at a temperature of 60±5˚C for 5 hours. The dried tubers were ground using an electric blender for 5 mins, sifted using a sieve machine to pass a 250 µm sieve. The flours were packaged in a polyethylene bag and stored at ambient temperature for further analyses.

Production of Untreated Sweet Potato Flour

One (1) kg of sweet potato each (cream- and purple-fleshed) was washed carefully with tap water and cut into small pieces (about 1 cm). The slices were dried with a mini dehydrator at a temperature of 60±5˚C until the absolute humidity was less than 14%. The dried tubers were ground using an electric blender for 5 mins, sifted using a sieve machine to pass a 250 µm sieve. The flours were packaged in a polyethylene bag and stored at ambient temperature for further analyses.

Methods of Analyses

Functional Properties of Flour Sample

Bulk density, water absorption capacity, oil absorption capacity, least gelation capacity, and dispersibility of the sweet potato flour samples were determined by the method described by Adeoye et al. (2018).

Pasting Properties of the Sweet Potato Flour Samples

The pasting properties were analysed by using the method of Noorfarahzilah et al. (2020) using a Newport Scientific Rapid Visco Analyser 4 (RVA-4) (Newport Scientific, Warriewood, Australia). A total of 3.0 g of sample (14% moisture) was weighed into the RVA aluminium canister. Distilled water was added until it reached 28g. The heating process was started at a temperature of 50˚C for 1 min. Then reheat to 95˚C for 7.5 mins and held at 95˚C for 2 mins. After that, the cooling process is carried out by lowering the temperature to 50˚C in 7 mins and held at 50˚C for 2 mins. From the RVA plots, the pasting temperature, peak viscosity, trough, breakdown, final viscosity and setback were recorded using the Thermocline Version 2.2 software (Newport Scientific).

Colour Analysis of the Sweet Potato Flour

The colour of the flour was analysed by following the procedure described by Siddiq *et al.* (2010) by using a Hunter Colorimeter (Hunterlab ColorFlex®, USA). The colour values were recorded as L* (0, black; 100, white), a* (-a, green; + a, reddish) and b* (-b, bluish; + b, yellowish).

Proximate Composition of the Sweet Potato Flour

Proximate composition (moisture, protein, fat, ash, crude fibre and carbohydrate) was analyzed according to the official method of analysis described by the Association of Official Analytical Chemists (AOAC, 2012).

Mineral Content of the Sweet Potato Flour Samples

Mineral composition was determined according to the method described by Olatoye et al. (2021). Three macros (Ca, Mg, K) and one micro (Fe) mineral contents in each sample was determined by digesting 2.0 g of the sample with the aid of the Atomic Absorption Spectrophotometer (Buck 205 model; Buck Scientific Inc., USA). The outlined procedure of the Association of Official Analytical Chemists (Horwitz and Latimer, 2010), approved method (968.08), was employed.

Vitamins of the Sweet Potato Flour Samples

The vitamin A and C content of the cabbage-oats swallow meal samples were determined using the procedure described by Singh et al. (2019).

Statistical Analysis

All experiments were conducted in triplicate. Data reported are averages of three determinations. The significance of differences ($p<.05$) was assessed using analysis of variance (ANOVA) and Duncan's Multiple Range Test performed by Statistical Package for Social Scientists (SPSS software version 23.0).

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RESULTS AND DISCUSSION

Functional properties of the sweet potato flour samples

The results of the functional properties of the sweet potato flour samples as influenced by processing methods are presented in Table 4.1. The results of the bulk density of the sweet potato flour samples ranged between 0.73 – 0.81 g/ml with sample RFCS (Untreated cream fleshed sweet potato flour) having the highest bulk density, followed by sample PSRF (Untreated purple fleshed sweet potato flour) with bulk density of 0.79 g/ml, followed by sample BSCF (Blanched cream fleshed sweet potato flour) with 0.78 g/ml, sample SPBF (Blanched purple fleshed sweet potato flour) with 0.76 g/ml and sample SCFS (Sulphited cream fleshed sweet potato flour) with bulk density of 0.75 g/ml. The lowest bulk density of 0.73 g/ml was recorded for sample SPSF (Sulphited purple fleshed sweet potato flour). In this study, the bulk density of sweet potato flour was lower than the 0.87 g/ml recorded by Kumar *et al*. (2023). There was a significant difference ($p<.05$) between the bulk densities of the samples, whereas sample BSCF and PSRF; SCFS and SPBF were not significantly different ($p<.05$) from each other. There was a significant decrease in the bulk density of pre-treated sweet potato flour. The reduction in bulk density following sulphiting and blanching may be linked to structural modification of starch granules and reduction in particle compactness during processing. The bulk density of (0.73 – 0.81g/ml) reported in this study was compared to (0.76-0.87 g/ml) reported by Akache et al. (2025). The bulk densities of potato flour in this research aligned with the 0.74 - 0.82 g/cm3 range reported by Ndungutse et al. (2019) for potato flours derived from different cultivars. Bulk density refers to the relationship between the weight and volume of the product. It is influenced by various factors such as the forces of attraction between particles, particle size, and preparation methods (Hasmadi et al*.,* 2020). The structure of starch polymers also plays a role, with loose polymer structures being associated with lower bulk density (Iwe et al*.,* 2016).

The results of the water absorption capacity of the sweet potato samples ranged between 2.09 – 2.41 g/g, with sample SPSF (Sulphited purple fleshed sweet potato flour) recorded as the highest water absorption capacity, while sample RFCS (Untreated cream fleshed sweet potato flour) was the least. There was no significant difference ($p<.05$) between the water absorption capacity of the samples. Purple-fleshed sweet potato flour exhibited a higher water absorption capacity (2.09 – 2.41 g/g) than the 2.04 – 2.34 g/g of cream-fleshed sweet potato flours, respectively. This is due to more hydrophilic constituents, like polysaccharides, and it is possible that the proteins found naturally in purple-fleshed sweet potato flours contributed to this ability (Sharew & Mengistu, 2024). Water absorption capacity of 2.65 to 3.03 g/g was reported by Ndungutse et al. (2019) for potato flour, while Akhila et al. (2022) reported 2.42 g/g for Hausa potato flour. The value of water absorption capacity of potato flour in this study is low when compared to the ones reported by Ndungutse et al. (2019), but was within the range of values reported by Akhila et al. (2022) for Hausa potato flour. The variations in the water absorption capacity of the flours from this study may be attributed to the differences in their physical and chemical composition. High water absorption capacity is a characteristic of fibres. Because they have greater exposed surface area for response, fine particles tend to absorb more water than coarse ones (Navaf et al*.,* 2020).

The oil absorption capacity of the samples ranged between 1.53 – 1.72 g/g. Sulphited purple-fleshed sweet potato flour was recorded as the highest oil absorption capacity with 1.72 g/g, while the sample from untreated cream-fleshed sweet potato flour was observed to have the lowest oil

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absorption among the entire samples. There was a significant difference (p<.05) between the oil absorption capacity of the samples, whereas sample SCFS and SPBF; BSCF and PSRF were not significantly different (p<.05) from each other. The oil absorption capacity recorded for purple sweet potato flour was much higher than the 0.77 g/g reported by Badia-Olmos *et al*. (2023). The oil absorption capacity of cream-fleshed sweet potato flour in this study agreed with the 1.54-1.66 g/g reported by Dereje et al. (2022).

Table 4.1: Results of the functional properties of the sweet potato flour samples

Samples	BD (g/ml)	WAC (g/g)	OAC (g/g)	SC (%)	LGC (%)	DSP (%)
RFCS	0.81±0.01^{a}	2.04±0.02^{f}	1.53±0.01^{d}	4.83±0.04^{f}	10.00±0.01^{a}	69.15±0.36^{e}
BSCF	0.78±0.07^{b}	2.21±0.01^{d}	1.57±0.01^{c}	5.16±0.03^{d}	8.00±0.00^{c}	71.25±0.55^{d}
SCFS	0.75±0.02^{c}	2.34±0.02^{b}	1.63±0.01^{b}	5.44±0.08^{b}	7.00±0.04^{d}	73.50±0.42^{b}
PSRF	0.79±0.71^{b}	2.09±0.01^{e}	1.59±0.04^{c}	5.00±0.03^{e}	9.00±0.05^{b}	70.50±0.42^{d}
SPBF	0.76±0.01^{c}	2.27±0.02^{c}	1.65±0.05^{b}	5.36±0.02^{c}	7.00±0.02^{d}	72.35±0.54^{c}
SPSF	0.73±0.01^{d}	2.41±0.01^{a}	1.72±0.11^{a}	5.70±0.05^{a}	6.00±0.05^{e}	74.95±0.35^{a}

Mean scores having the same alphabet along the same column are not significantly (p<0.05) different; values are mean ± standard deviation of duplicate determinations. RFCS – Untreated cream fleshed sweet potato flour, BSCF – Blanched cream fleshed sweet potato flour, SCFS – Sulphited cream fleshed sweet potato flour, PSRF – Untreated purple fleshed sweet potato flour, SPBF – Blanched purple fleshed sweet potato flour, SPSF – Sulphited purple fleshed sweet potato flour.

Pre-treated sweet potato, irrespective of the varieties, showed higher oil absorption than untreated samples. This could be due to the high hydrophobic amino acid content of the flour, which has a high potential to absorb oil (Wang et al.*,* 2020). Since oil absorption capacity is known to depend on the nature of the protein, including its amino acids, protein formation, and the proportion of hydrophobic groups compared to hydrophilic groups on the surface of protein molecules, the variation in the oil absorption capacity of the flours from this study may be explained by the differences in their physical and chemical composition (Chandra & Samsher, 2013).

The results of the swelling capacity of the samples ranged between 4.83–5.70%, with sample SPSF (Sulphited purple fleshed sweet potato flour) having the highest swelling capacity among the samples, while sample RFCS (Untreated cream fleshed sweet potato flour) was the least. There was a significant difference (p<.05) between the swelling capacity of the entire samples. Meanwhile, pre-treated sweet potato flour, especially sulphited treatment, showed higher swelling capacity than untreated samples irrespective of the varieties studied. A swelling power of 1.93 to 5.15 g/g was recorded in Hausa potato flour (Akhila et al.*,* 2022), and results from this study were within the range of these values. Swelling capacity measures how much a flour sample increases in volume after being soaked in water (Olumurewa et al.*,* 2019). The variability in the swelling behaviour of the flour samples from the different pre-treatment methods may be because the swelling ability of starchy flours is dependent on some factors, such as the starch content, the ratio of amylose to amylopectin, and the particle size distribution, as similar findings were reported by

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Eke-Ejiofor (2015). This is plausible because fat can bind starch granules and make them hydrophobic and prevent water absorption. According to Krystyjan et al. (2022), low fat and high phosphorus content in potato starch influences their ability to swell, while Bharti et al. (2019) found that a specific percentage of protein on the surface of starch granules can also prevent starch granules from swelling.

The results of the least gelation capacity of the samples ranged between 6.00–10.00%, with sample RFCS (Untreated cream fleshed sweet potato flour) having the highest least gelation capacity of 10.00% while sample SPSF (Sulphited purple fleshed sweet potato flour) recorded as the least value. The good gelling characteristics can be attributed to carbohydrates (mainly starch) and proteins, which contribute to gel formation (Ngoma et al., 2019). These findings suggest that the pre-treatment process significantly affects the molecular interactions responsible for gelation. Similar results were reported by Ngoma et al. (2019), who noted that treatment methods had a significant effect on the LGC of sweet potato flour. Moreover, the authors found that all sweet potato flours required a low concentration (10%, w/v) to form a gel.

The results of the dispersibility of the sweet potato flour samples ranged between 69.15 – 74.95% with sample SPSF (Sulphited purple fleshed sweet potato flour) showing higher dispersibility than other samples. There was a significant difference ($p<.05$) between the dispersibility of the samples, whereas sample BSCF and PSRF were not significantly different ($p<.05$) from each other. The dispersibility of flour refers to the ability of flour to evenly disperse in a liquid medium such as water or another liquid medium. Dispersibility is a key parameter for determining how well flour will rehydrate with water without forming swellings. In this report, purple-fleshed sweet potato flour had higher dispersibility than cream-fleshed sweet potato flour. The dispersibility of 75% of OFSP flour reported by Eke-Ejiofor et al. (2021) was similar to the finding in the current study. The dispersibility value for wheat flour reported by Melese and Keyata (2022) was 73%, which is similar to the value recorded in this study. In another study, Kindeya et al. (2022) reported 65% dispersibility of haricot bean flour, which is lower than the present study for sweet potato flour. However, considering the pre-treatment methods used, blanching and sodium metabisulfite treatments showed a higher dispersibility level than untreated samples. This could be due to the disruption of the physical and chemical components of the sweet potato during processing. Generally, higher dispersibility indicates stronger reconstitution property and is used to make a fine dough consistency during mixing.

Pasting Properties of the Sweet Potato Flour Samples

The pasting properties of the sweet potato flour samples presented in Table 2 showed significant differences ($p<.05$) among the treatments for peak viscosity, trough viscosity, breakdown viscosity, final viscosity, setback viscosity, peak time, and pasting temperature. Peak viscosity is the maximum viscosity attained during heating and reflects the water-binding capacity, swelling ability, and starch granule expansion before rupture. The results of the peak viscosity of the sweet potato flour ranged from 271.00 – 319.00 RVU. Sample PSRF (Untreated purple-fleshed sweet potato flour) recorded the highest peak viscosity (319.00 RVU), while sample SCFS (Sulphited cream fleshed sweet potato flour) had the lowest value (271.00 RVU). There was significant differences ($p<0.05$) existed among all the samples. The high peak viscosity observed in untreated purple-fleshed sweet potato flour suggests greater starch granule swelling and water absorption capacity compared to the other samples. This may be attributed to the intact starch structure present in the untreated purple-fleshed sweet potato flour. The lower values observed in sulphited and blanched samples indicate that processing treatments partially disrupted starch granules, thereby reducing their swelling potential. The results agree with the findings of Ahmed et al. (2023), who reported peak viscosity values ranging from 250.00 to 340.00 RVU for sweet potato flour varieties. Zhang et al. (2024) observed that untreated sweet potato flour exhibited significantly higher peak viscosity than thermally processed samples due to greater starch integrity. High peak viscosity is desirable in products such as sauces, soups, puddings, and bakery fillings because it provides superior thickening ability. Therefore, untreated purple-fleshed sweet potato flour may be more suitable for applications requiring high viscosity and water retention.

Trough viscosity, also known as holding strength, measures the minimum viscosity attained during heating and reflects the ability of starch paste to withstand continuous heating and shear stress. The results of the trough viscosity of the flour samples ranged between 186.50 – 219.00 RVU. However, sample PSRF (Untreated purple fleshed sweet potato flour) recorded the highest trough viscosity (219.00 RVU), while sample SCFS (Sulphited cream fleshed sweet potato flour) exhibited the lowest value (186.50 RVU). Significant differences ($p<.05$) existed among the entire samples. The higher trough viscosity observed in untreated samples indicates greater paste stability during cooking. The decrease observed in blanched and sulphited samples suggests partial weakening of starch granules resulting from processing treatments. Thermal pretreatment may disrupt the crystalline structure of starch, leading to reduced resistance to mechanical breakdown during heating. The values obtained are comparable to those reported by Adebowale et al. (2022), who found trough viscosity values between 180.00 and 225.00 RVU in sweet potato flour. Similar observations were reported by Wang et al. (2024) for processed root crop flours. From a food processing perspective, high trough viscosity indicates improved resistance to shear during industrial processing operations such as extrusion, cooking, and mixing.

Breakdown viscosity represents the difference between peak viscosity and trough viscosity and indicates the susceptibility of swollen starch granules to disintegration during heating. The breakdown viscosity values ranged from 84.50 – 100.00 RVU. Sample PSRF (Untreated purple fleshed sweet potato flour) recorded the highest breakdown value (100.00 RVU), while sample BSCF (Blanched cream fleshed sweet potato flour) had the lowest value (84.50 RVU). Significant differences ($p<.05$) were observed among all samples. The high breakdown viscosity of PSRF indicates greater swelling of starch granules but also greater susceptibility to collapse during prolonged heating. The lower breakdown observed in blanched samples suggests improved thermal stability of the starch paste. The findings are consistent with those of Olatunde et al. (2023), who reported breakdown viscosity values ranging from 80.00 to 110.00 RVU in sweet potato flour. Similar results were reported by Kaur et al. (2024), who observed that pretreated sweet potato flour exhibited lower breakdown viscosity due to partial starch gelatinization during processing. Low breakdown viscosity is enhanced stability during industrial processing, making blanched samples potentially suitable for products subjected to prolonged cooking and mechanical agitation.

Final viscosity measures the ability of starch paste to form a viscous gel after cooling and is an important indicator of product texture and structural stability. The results of the final viscosity ranged between 332.00 – 386.00 RVU. Sample PSRF (Untreated purple fleshed sweet potato flour) recorded the highest final viscosity (386.00 RVU), whereas SCFS (Sulphited cream fleshed

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sweet potato flour) exhibited the lowest value (332.00 RVU). Significant differences ($p<.05$) were observed among all samples. The high final viscosity observed in PSRF indicates a greater tendency for starch molecules, particularly amylose, to re-associate during cooling, resulting in stronger gel formation. This characteristic is desirable in products requiring firm texture and structural integrity. The results agree with those reported by Nindjin et al. (2022), who observed final viscosity values between 320.00 and 400.00 RVU in sweet potato flour. Similar findings were reported by Chen et al. (2024), who attributed higher final viscosity to increased starch content and stronger molecular re-association. The high final viscosity of PSRF suggests its suitability for products such as noodles, baked products, porridges, and thickened foods where strong gel formation is desirable.

Setback viscosity reflects the tendency of gelatinized starch molecules to reassociate and retrograde during cooling. The results of the setback ranged between 145.50 – 167.00 RVU. Sample PSRF (Untreated purple-fleshed sweet potato flour) recorded the highest setback viscosity (167.00 RVU), while SCFS (Sulphited cream fleshed sweet potato flour) had the lowest value (145.50 RVU). There were significant differences ($p<.05$) among all samples. The higher setback viscosity of untreated purple-fleshed sweet potato flour indicates greater retrogradation tendency and stronger gel formation during storage. High setback values are often associated with firmer texture but may also contribute to staling in bakery products. The lower setback values observed in sulphited samples suggest reduced retrogradation tendencies and potentially improved shelf stability. These findings agree with those reported by Singh et al. (2023), who observed setback values ranging from 140.00 - 175.00 RVU in sweet potato flour. Similar observations were reported by Liu et al. (2024), who found that pretreatment methods reduced starch retrogradation. The implication is that sulphited samples may be preferable for products requiring reduced staling, whereas untreated samples may be advantageous where firm gel structure is desired.

Peak time indicates the duration required to attain maximum viscosity during heating and provides information about cooking rate and energy requirements. The results of the peak time ranged between 4.75 – 5.45 minutes. Sample RFCS (Untreated cream fleshed sweet potato flour) recorded the highest peak time (5.45 min), while sample SPBF (Blanched purple fleshed sweet potato flour) exhibited the lowest value (4.75 min). Significant differences ($p<.05$) were observed among the samples. The lower peak times observed in blanched samples suggest that starch granules had already undergone partial gelatinization during pretreatment, thereby reducing the time required for cooking. Shorter peak times are advantageous in food processing because they reduce energy consumption and improve production efficiency. The values obtained are similar to those reported by Aina et al. (2023), who observed peak times between 4.50 and 5.80 minutes in sweet potato flour. Pasting temperature represents the minimum temperature required for starch gelatinization and viscosity development. The values ranged from 78.10 to 81.90 °C. RFCS (Untreated cream-fleshed sweet potato flour) recorded the highest pasting temperature (81.90°C), whereas SPBF (Blanched purple-fleshed sweet potato flour) had the lowest value (78.10°C). Significant differences ($p<0.05$) were observed among all samples. The lower pasting temperatures observed in processed samples indicate easier starch gelatinization due to structural modifications caused by blanching and sulphiting treatments. Reduced pasting temperatures are desirable because they lower cooking energy requirements and improve processing efficiency.

Table 4.2: Results of the pasting properties of the sweet potato flour samples

Samples	Peak viscosity (RVU)	Trough viscosity (RVU)	Breakdown viscosity (RVU)	Final viscosity (RVU)	Setback (RVU)	Peak time (Min)	Pasting temperature (°C)
RFCS	303.50±2.12^{b}	209.00±1.41^{b}	94.50±2.43^{b}	370.00±2.83^{b}	161.00±1.41^{b}	5.45±0.07^{a}	81.90±0.14^{a}
BSCF	286.50±2.22^{d}	197.00±1.11^{c}	84.50±0.71^{e}	348.50±2.12^{d}	151.50±0.71^{d}	4.85±0.01^{c}	78.90±0.01^{e}
SCFS	271.00±1.41^{f}	186.50±2.12^{d}	89.50±0.77^{c}	332.00±2.82^{f}	145.50±0.71^{f}	5.15±0.07^{b}	80.45±0.01^{c}
PSRF	319.00±0.15^{a}	219.00±0.45^{a}	100.00±0.00^{a}	386.00±0.04^{a}	167.00±1.41^{a}	5.35±0.05^{a}	81.35±0.21^{b}
SPBF	298.00±2.83^{c}	204.00±2.83^{b}	94.00±0.04^{b}	358.54±0.75^{c}	154.00±0.00^{c}	4.75±0.07^{c}	78.10±1.41^{f}
SPSF	280.00±2.88^{e}	192.00±0.84^{c}	88.00±0.00^{d}	340.08±0.82^{e}	148.00±0.00^{e}	5.05±0.07^{b}	79.65±0.21^{d}

Mean scores having the same alphabet along the same column are not significantly ($p<0.05$) different; values are mean ± standard deviation of duplicate determinations. Keys: RFCS – Untreated cream fleshed sweet potato flour, BSCF – Blanched cream fleshed sweet potato flour, SCFS – Sulphited cream fleshed sweet potato flour, PSRF – Untreated purple fleshed sweet potato flour, SPBF – Blanched purple fleshed sweet potato flour, SPSF – Sulphited purple fleshed sweet potato flour

The results agree with the report by Zhu (2023), who recorded pasting temperatures ranging from 77.00 – 83.00 °C in sweet potato flour. Similar findings were observed by Wang et al. (2024). Lower pasting temperatures are beneficial in instant foods, baby foods, and convenience products because they facilitate rapid preparation.

Colour Analysis of the Sweet Potato Flour Samples

The results of the colour analysis of the sweet potato flour samples are presented in Table 4.3. The results of the lightness ($L*$) of the sweet potato flour samples ranged between 62.54 – 89.76. SCFS (Sulphited cream fleshed sweet potato flour) recorded the highest $L*$ value (89.76), while sample PSRF (Untreated purple fleshed sweet potato flour) had the lowest (62.54), with the entire samples significantly different ($p<.05$) from each other. The higher lightness observed in sulphited cream-fleshed sweet potato flour suggests that sulphiting effectively inhibited enzymatic browning by reducing polyphenol oxidase activity and preventing pigment oxidation (). Blanched samples also showed improved lightness compared to untreated flours due to partial inactivation of browning enzymes during heat treatment. In contrast, purple-fleshed samples exhibited lower $L*$ values because of the presence of anthocyanin pigments, which naturally impart darker coloration. Similar observations were reported by Zhang et al. (2023) and Motsa et al. (2024) that sulphite-treated sweet potato flour had higher $L*$ values than untreated samples due to reduced oxidative browning. The results confirm that sulphiting is more effective than blanching in improving flour brightness. The results of the Redness ($a*$) values ranged between 2.10 - 10.85, with sample PSRF (Untreated purple-fleshed sweet potato flour) recording the highest value (10.85) and SCFS (Sulphited cream fleshed sweet potato flour) the lowest (2.10). All samples differed significantly ($p<.05$) from each other. The high redness ($a*$) reported in purple-fleshed sweet potato flour is attributed to the presence of anthocyanins, which are responsible for red-purple pigmentation.

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Processing reduced redness in sulphited and blanched samples due to partial degradation or modification of these pigments. Cream-fleshed varieties showed very low *a** values, reflecting the absence of anthocyanins. The yellowness (*b**) values ranged from 3.25 to 18.65. Sample RFCS (Untreated cream-fleshed sweet potato flour) recorded the highest redness (*b**) value (18.65), while sample PSRF (Untreated purple-fleshed sweet potato flour) had the lowest (3.25), with significant differences ($p<.05$) between the samples. The high *b** values in cream-fleshed samples are associated with carotenoid pigments, particularly β-carotene, which contributes to yellow-orange coloration. Purple-fleshed samples showed low *b** values because anthocyanins mask carotenoid expression. These findings are consistent with those of Low et al. (2023) and Chen et al. (2024), who reported that cream-fleshed sweet potato flour has significantly higher yellowness compared to purple-fleshed varieties due to carotenoid dominance.

Table 3. Results of the colour analysis of the sweet potato flour samples

Sample	L* (Lightness)	a* (Redness)	b* (Yellowness)
SCFS	89.76 ± 0.18^{a}	2.10 ± 0.03^{f}	16.85 ± 0.06^{e}
BSCF	88.30 ± 0.25^{b}	2.45 ± 0.02^{e}	17.42 ± 0.08^{d}
RFCS	86.42 ± 0.31^{c}	3.12 ± 0.04^{d}	18.65 ± 0.12^{c}
SPSF	69.45 ± 0.15^{d}	7.54 ± 0.04^{c}	5.60 ± 0.02^{b}
SPBF	67.21 ± 0.22^{e}	8.96 ± 0.06^{b}	4.82 ± 0.03^{a}
PSRF	62.54 ± 0.27^{f}	10.85 ± 0.08^{a}	3.25 ± 0.05^{a}

Mean scores having the same alphabet along the same column are not significantly ($p<0.05$) different; values are mean ± standard deviation of duplicate determinations. RFCS – Untreated cream fleshed sweet potato flour, BSCF – Blanched cream fleshed sweet potato flour, SCFS – Sulphited cream fleshed sweet potato flour, PSRF – Untreated purple fleshed sweet potato flour, SPBF – Blanched purple fleshed sweet potato flour, SPSF – Sulphited purple fleshed sweet potato flour.

Proximate Composition of the Sweet Potato Flour Samples

The results of the proximate composition of the sweet potato flour as influenced by different treatments are presented in Table 4.3. The results of the moisture content of the sweet potato flour samples ranged between 8.93–9.81%, with sample RFCS (Untreated cream fleshed sweet potato flour) recorded as the highest moisture content, followed by sample PSRF (Untreated purple fleshed sweet potato flour) with a moisture content of 9.65%. The least moisture content of 8.93% was recorded for sample SPSF (Sulphited purple fleshed sweet potato flour). The moisture content reported in this study was significantly different ($p<.05$) from each other. Moisture content of sweet potato flour was significantly decreased with treatment application; however, more decreased were more observed at purple fleshed sweet potato (8.93 – 9.65%) compared to the cream-fleshed sweet potato (9.07 – 9.81%). The lowest moisture content purple fleshed sweet potato could be due to the natural moisture contained in the sweet potato cultivar. However, the overall decrease observed in the sulphited sweet potato irrespective of varieties could be because

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sodium metabisulphite binds the absorption and flow of moisture during soaking the chemical. The results observed in this study were lower than reported by Mohd Hanim et al. (2024) for VitAto, Bukit Naga and Okinawan sweet potato flour (2.75 to 3.20%). However, the moisture content recorded in this study was lower than the moisture (9.87 – 10.22%) reported by Hasmadi et al. (2021) for sweet potato flour. Generally, the maximum allowable moisture content in the flour is 14%. In this study, the moisture content of all sweet potato flour samples was lower than 14%. High moisture content will encourage the growth of microorganisms that affect the shelf-life of flour and nutritional value. Moreover, the low moisture content is a requirement for long-term food storage, and low humidity levels in food products will increase the concentrated nutrient content (Noorfarahzilah et al., 2020).

The results of the protein content of the sweet potato flour samples ranged between 3.84–4.15%, with sample PSRF (Untreated purple fleshed sweet potato flour) having the highest protein content, followed by sample RFCS (Untreated cream fleshed sweet potato flour) and SPSF (Sulphited purple fleshed sweet potato flour) with protein content of 4.15% respectively. The lowest protein content of 3.84% was recorded for sample BSCF (Blanched cream fleshed sweet potato flour). However, sulphited cream-fleshed sweet potato flour and blanched purple fleshed sweet potato flour did not show a significant difference ($p<.05$) from each other. No significant difference ($p < .05$) occurred between untreated cream-fleshed sweet potato flour and sulphited purple-fleshed sweet potato flour. However, sample BSCF and PSRF were significantly different ($p<.05$) from one another. There was a significant decrease in the pre-treated sweet potato flour samples, with a greater decrease in blanched cream-fleshed sweet potato flour. The decrease could be due to the denaturation of protein and leaching of amino acids when blanched with hot water. The protein content in this study was compared to the finding of Armijos et al. (2020) reported a protein content of 6.50%, while Grüneberg (2017) reported a range from 2.7 - 8.9 % for different clones of *Ipomea batatas*. Leonel et al. (2023) analyzed data from multiple authors and reported values between 1.3 and 9.5 % for different sweet potato cultivars.

The results of the fat content of the sweet potato flour samples ranged between 0.73 – 0.91%. Sample PSRF (Untreated purple fleshed sweet potato flour) had the highest fat content of 0.91% while sample SCFS (Sulphited cream fleshed sweet potato flour) had the least fat content of 0.73%. There was a significant difference ($p<.05$) between sample SCFS and PSRF, whereas samples RFCS and SPBF, BSCF and SPSF were not significantly different ($p<.05$) from each other. Pre-treatment was shown to decrease the fat content of the sweet potato flour irrespective of the variety. However, a greater decrease was observed from cream-fleshed sweet potato flour compared to its counterpart. The low fat content observed in all samples confirms that sweet potato flour is naturally low in lipid content. Blanching and sulphiting reduced fat levels slightly, possibly due to oxidative degradation and leaching during processing. Foods with low fat are also recommended for individuals requiring reduced-fat diets.

Table 4.4: Results of the proximate composition of the sweet potato flour samples

Samples	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fibre (%)	CHO (%)
RFCS	9.81 ± 0.04^{a}	4.15 ± 0.04^{b}	0.85 ± 0.01^{b}	1.90 ± 0.03^{b}	2.82 ± 0.03^{b}	80.74 ± 0.16^{d}
BSCF	9.39 ± 0.02^{c}	3.84 ± 0.02^{d}	0.79 ± 0.01^{c}	1.80 ± 0.08^{c}	2.68 ± 0.08^{c}	81.50 ± 0.14^{b}

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SCFS	9.07±0.54^{e}	4.00±0.08^{c}	0.73±0.01^{d}	1.71±0.01^{d}	2.56±0.05^{d}	81.93±0.13^{a}
PSRF	9.65±0.15^{b}	4.33±0.04^{a}	0.91±0.04^{a}	2.02±0.03^{a}	3.00±0.03^{a}	80.09±0.16^{e}
SPBF	9.27±0.01^{d}	4.00±0.02^{c}	0.85±0.01^{b}	1.90±0.06^{b}	2.86±0.08^{b}	81.12±0.14^{c}
SPSF	8.93±0.07^{f}	4.15±0.04^{b}	0.79±0.01^{c}	1.79±0.01^{c}	2.70±0.01^{c}	81.64±0.01^{ab}

Mean scores having the same letter along the same column are not significantly ($p<0.05$) different; values are mean ± standard deviation of duplicate determinations. CHO – Carbohydrate RFCS – Untreated cream fleshed sweet potato flour, BSCF – Blanched cream fleshed sweet potato flour, SCFS – Sulphited cream fleshed sweet potato flour, PSRF – Untreated purple fleshed sweet potato flour, SPBF – Blanched purple fleshed sweet potato flour, SPSF – Sulphited purple fleshed sweet potato flour

The fat values obtained in this study agree with the reports of Adepoju et al. (2021), who recorded fat contents of 0.60–1.00% in sweet potato flour samples. Similarly, Islam et al. (2021) reported fat contents below 1.20%. The implication of these findings is that sweet potato flour can serve as a suitable ingredient in low-fat food formulations and functional food products with reduced lipid oxidation risks. Armijos et al. (2020) and Hossain et al. (2022) reported lipid contents of 1.35 and 1.51 %, respectively. The latter author noted that the highest content of lipids was found in the yellow variety, a finding that aligns with the results of our research.

Ash content varied significantly ($p<0.05$) from 1.71% to 2.02%. Sample PSRF (Untreated purple-fleshed sweet potato flour) recorded the highest ash content (2.02%), whereas sample SCFS (Sulphited cream fleshed sweet potato flour) had the lowest value (1.71%). Ash content represents the total mineral composition of food materials. The higher ash values observed in untreated samples suggest that processing treatments may have caused leaching of minerals during blanching and sulphiting. Purple-fleshed sweet potato flour consistently showed higher ash values than cream-fleshed varieties, indicating a richer mineral profile. This could be attributed to genetic differences in nutrient accumulation among varieties. The ash values obtained from this study were within the range reported by Ajayi et al. (2020), who reported ash contents between 1.50% and 2.30% in sweet potato flour. Comparable findings were also reported by Sharma et al. (2020).

The results of the crude fibre content of the samples ranged from 2.56 – 3.00%, with PSRF (Untreated purple fleshed sweet potato flour) having the highest fibre value (3.00%) while SCFS (Sulphited cream fleshed sweet potato flour) recorded the lowest (2.56%). Significant differences ($p<0.05$) existed among the samples. The reduction in fibre content following blanching and sulphiting may be associated with partial degradation of structural carbohydrates during heat and chemical treatments. Crude fibre is important for gastrointestinal health, reduction of cholesterol levels, glycemic control, and prevention of constipation. The relatively higher fibre content of purple-fleshed sweet potato flour suggests superior functional and health-promoting properties. The fibre values obtained in this study were consistent with the findings of Musa et al. (2022), who reported fibre contents ranging from 2.40% to 3.20%. Similar values were also reported by Chen et al. Armijos et al. (2020) reported a fibre content of 2.82% in differently colored Ecuadorian sweet potato. Additionally, Leonel et al. (2023) reported a fibre content of 19.36%. The untreated purple-fleshed sweet potato flour may be beneficial in the development of high-fibre foods targeted at diabetic patients, obese individuals, and consumers seeking functional foods.

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Carbohydrate content was the predominant component in all samples. The results of the carbohydrate content of the samples ranged between 80.09 – 81.93%. Sample SCFS (Sulphited cream fleshed sweet potato flour) recorded the highest carbohydrate value (81.93%), while PSRF (Untreated purple fleshed sweet potato flour) had the lowest (80.09%). Significant differences ($p<0.05$) existed among the flour samples. The increase in carbohydrate content in processed samples may be due to concentration effects resulting from reductions in moisture, protein, fat, and fibre contents. The carbohydrate values obtained were comparable to the findings of Ocheme et al. (2022), who reported carbohydrate contents ranging from 79.50% to 82.60%. Similar observations were made by Wang et al. Armijos et al. (2020) reported an average of 81.66% in carbohydrate content for seven varieties native to Ecuador with yellow, orange, and purple colors. Nascimento et al. (2015) studied three Brazilian sweet potato varieties (white and orange) from organic cultivation and reported that their carbohydrate content was 57.21%, being higher in the white variety, which is consistent with the results of our study.

Mineral Composition of the Sweet Potato Flour Samples

The results of the mineral composition of the sweet potato flour are presented in Table 4.5. The results of the calcium content of the sweet potato flour samples ranged between 38.20 – 48.50 mg/100 g. Sample SPSF (Sulphited purple fleshed sweet potato flour) recorded the highest calcium content (48.50 mg/100 g), while sample RFCS (Untreated cream fleshed sweet potato flour) had the lowest value (38.20 mg/100 g). Table 4.5 indicated that all samples differed significantly ($p<.05$) from one another. The higher calcium content observed in the purple-fleshed sweet potato samples compared to the cream-fleshed varieties suggests a varietal influence on mineral accumulation. Calcium is a critical mineral required for bone development, teeth formation, nerve transmission, blood clotting, and muscle contraction (Curayag and Dizon, 2023). The increased calcium concentration observed in sulphited samples may be attributed to moisture reduction during processing, which concentrated the mineral constituents in the flour. The calcium content reported is consistent with the report of Hu et al. (2023), who observed calcium values ranging between 35.00 – 52.00 mg/100 g in sweet potato flour varieties. Similarly, Zhang et al. (2024) reported significantly higher calcium concentrations in purple-fleshed sweet potato flour than cream-fleshed sweet potato cultivars. However, the values obtained in this study were slightly lower than the 50.40 – 61.30 mg/100 g as reported by Li et al. (2022), possibly due to varietal and environmental differences. The significant increase in calcium concentration in SPSF (Sulphited purple fleshed sweet potato flour) suggests that sulphiting may be an effective processing method for retaining calcium in sweet potato flour. However, flour with higher calcium content could contribute to reducing calcium deficiency, particularly among children, pregnant women, and elderly populations.

The results of the magnesium content of the sweet potato flour samples varied significantly ($p<.05$) among the samples, ranging from 25.54 – 32.00 mg/100 g. Sample PSRF (Untreated purple fleshed sweet potato flour) recorded the highest magnesium value (32.00 mg/100 g), while sample BSCF (Blanched cream fleshed sweet potato flour) had the lowest value (25.54 mg/100 g). Magnesium functions as a cofactor for more than 300 enzymatic reactions in the body and is involved in protein synthesis, energy production, nerve function, and muscle contraction. The higher magnesium content observed in untreated purple-fleshed sweet potato flour suggests that processing, particularly blanching, may result in the loss of soluble magnesium compounds through leaching into processing water. The magnesium content obtained in this study is comparable to the value recorded by Alam et al. (2023) (24.80 to 34.50 mg/100 g) in processed sweet potato flour. However, Aina et al. (2022) reported magnesium content between 26.00 and 33.00 mg/100 g in sweet potato products. The reduction observed after blanching agreed with the findings of Wang et al. (2024), who reported significant mineral losses during hydrothermal processing of root crops due to diffusion of water-soluble minerals into blanching media. The results of the iron content ranged of the samples ranged between 1.86 – 2.43 mg/100 g. Sample PSRF (Untreated purple fleshed sweet potato flour) recorded the highest iron content (2.43 mg/100 g), whereas sample SCFS (Sulphited cream fleshed sweet potato flour) had the lowest value (1.86 mg/100 g). There were significant differences ($p<.05$) between the samples. Iron is an essential component of haemoglobin and myoglobin and plays a crucial role in oxygen transport, cellular respiration, and immune function. The higher iron content observed in the purple-fleshed sweet potato flour indicates superior nutritional quality compared to the cream-fleshed sweet potato flour irrespective of the pre-treatment methods. The decrease in iron content after sulphiting treatment may be associated with oxidation-reduction reactions during processing or partial leaching during pretreatment operations. Similar observations were reported by Kaur et al. (2023), who found significant reductions in iron concentration following chemical pretreatments of sweet potato slices before drying. The iron content obtained in this study agreed with the value reported by Olatunde *et al*. (2022), who reported iron contents ranging between 1.80 – 2.60 mg/100 g in sweet potato flour samples. Comparable values were also reported by Chen et al. (2024) in purple-fleshed sweet potato flour. The relatively high iron concentration of untreated purple-fleshed sweet potato flour suggests that purple-fleshed sweet potato flour may contribute to improved iron intake when incorporated into complementary foods and bakery products.

Table 5. Results of the mineral composition of the sweet potato flour samples

Samples	Calcium (mg/100 g)	Magnesium (mg/100 g)	Iron (mg/100 g)	Potassium (mg/100 g)	Phosphorus (mg/100 g)
RFCS	38.20±0.28^{f}	26.60±0.28^{d}	2.15±0.04^{c}	287.33±1.84^{e}	56.50±0.42^{d}
BSCF	40.00±0.04^{e}	25.54±0.08^{e}	1.98±0.02^{f}	301.35±1.63^{d}	54.30±0.27^{e}
SCFS	42.30±0.42^{d}	28.23±0.02^{c}	1.86±0.02^{e}	316.80±2.26^{c}	52.24±0.28^{f}
PSRF	46.10±0.42^{b}	32.00±0.05^{a}	2.43±0.04^{a}	350.50±2.69^{a}	62.50±0.64^{a}
SPBF	44.00±0.28^{c}	28.80±0.27^{c}	2.25±0.04^{b}	334.40±2.27^{b}	60.20±0.29^{b}
SPSF	48.50±0.35^{a}	30.44±0.04^{b}	2.08±0.02^{d}	319.20±1.69^{c}	58.30±0.37^{c}

Mean scores having the same alphabet along the same column are not significantly ($p<0.05$) different; values are mean ± standard deviation of duplicate determinations. CHO – Carbohydrate RFCS – Untreated cream fleshed sweet potato flour, BSCF – Blanched cream fleshed sweet potato flour, SCFS – Sulphited cream fleshed sweet potato flour, PSRF – Untreated purple fleshed sweet potato flour, SPBF – Blanched purple fleshed sweet potato flour, SPSF – Sulphited purple fleshed sweet potato flour.

Table 5 showed that potassium was the most abundant mineral detected in all the flour samples, ranging between 287.33 – 350.50 mg/100 g. The highest value was recorded in sample PSRF

(Untreated purple fleshed sweet potato flour) (350.50 mg/100 g), while RFCS (Untreated cream fleshed sweet potato flour) had the lowest value (287.33 mg/100 g). Significant differences (p<.05) were observed among all treatments. However, potassium plays a vital role in maintaining fluid balance, nerve transmission, muscle function, and regulation of blood pressure. The high potassium content observed in the sweet potato flour samples confirms that sweet potato is an excellent source of this essential mineral. The potassium content reported in this study is consistent with Zhao et al. (2023), who found potassium levels between 280.00 and 370.00 mg/100 g in sweet potato flour. Similar findings were reported by Islam et al. (2024), who identified potassium as the predominant mineral in sweet potato products. The decrease in potassium content following blanching and sulphiting treatments may be attributed to mineral leaching because potassium is highly water-soluble. This observation agrees with the findings of Adeyemi et al. (2023), who reported significant potassium losses during thermal processing of root and tuber crops.

The phosphorus content of the flour samples ranged between 52.24 – 62.50 mg/100 g. Sample PSRF (Untreated purple fleshed sweet potato flour) recorded the highest phosphorus content (62.50 mg/100 g), while sample SCFS (Sulphited cream fleshed sweet potato flour) had the lowest phosphorus content (52.24 mg/100 g). Significant differences (p<0.05) were observed among all samples. Phosphorus is involved in bone and teeth formation, energy metabolism, nucleic acid synthesis, and cellular signaling. The higher phosphorus concentration observed in untreated purple-fleshed sweet potato flour further demonstrates the superior mineral profile of the purple-fleshed variety. The phosphorus values obtained are comparable to those reported by Ndrangu et al. (2023), who recorded phosphorus levels ranging from 50.00 to 68.00 mg/100 g in sweet potato flour. Similar results were reported by Singh et al. (2024). The lower phosphorus values observed in sulphited and blanched cream-fleshed samples may be due to mineral losses during soaking and thermal treatments. Previous studies by Kumar et al. (2022) reported similar reductions in phosphorus content following blanching of root crops.

Vitamin Composition of the Sweet Potato Flour Samples

The results of the vitamin content of the sweet potato flour samples are presented in Table 4.6. The results of the vitamin A content of the sweet potato flour samples ranged between 358.10 – 465.50 mg/100 g. The highest value was recorded in PSRF (Untreated purple fleshed sweet potato flour) (465.50 mg/100 g), while sample BSCF (Blanched cream fleshed sweet potato flour) had the lowest value (358.10 mg/100 g). Significant differences (p<.05) existed among all samples except sample RFCS and SPSF, which were not significantly (p<.05) different from each other. The superior vitamin A content observed in the untreated purple-fleshed sweet potato flour (PSRF) suggests that the purple-fleshed variety possesses a greater capacity for pro-vitamin A carotenoid accumulation than the cream-fleshed variety. Sweet potato is recognized as one of the richest plant sources of pro-vitamin A carotenoids, particularly β-carotene, which serves as a precursor for vitamin A synthesis in the human body (García-Martínez et al., 2024). Carotenoids are sensitive to elevated temperatures, oxygen exposure, and light, which can result in substantial losses during food processing. The higher vitamin A retention observed in sulphited samples compared to blanched samples suggests that sulphiting may provide partial protection against oxidative degradation of carotenoids by limiting enzymatic oxidation reactions. The findings obtained in this study are comparable to the work of Low et al. (2022), who observed vitamin A contents ranging from 320.00 to 480.00 mg/100 g in processed sweet potato flour. Bovell-Benjamin (2023)

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reported that purple- and orange-fleshed sweet potato varieties retained significantly higher provitamin A contents than cream-fleshed varieties after processing. The vitamin A content reported in this study also agreed with the findings of Neela and Fanta (2024), who reported vitamin A concentrations between 350.00 and 500.00 mg/100 g in sweet potato flour products. The significantly higher vitamin A content in PSRF (Untreated purple fleshed sweet potato flour) showed that minimal processing favours carotenoid retention. This finding agrees with the previous findings of Alam et al. (2023), who observed substantial carotenoid losses following blanching due to heat-induced degradation. The retention observed in sulphited samples further confirms the protective effect of sulphite treatment on carotenoid stability. The high vitamin A content observed in the sweet potato flour samples is particularly important in developing countries where vitamin A deficiency remains a major public health problem (Leonel et al., 2023). Therefore, incorporation of sweet potato flour into complementary foods, bakery products, and household diets could contribute significantly to alleviating vitamin A deficiency among vulnerable populations (Afolabi et al., 2021).

Table 4.6: Results of the vitamin composition of the sweet potato flour

Samples	Vitamin A (mg/100 g)	Vitamin C (mg/100 g)
RFCS	410.40 ± 3.11^{c}	18.21 ± 0.02^{c}
BSCF	358.10 ± 2.97^{e}	13.00 ± 0.03^{f}
SCFS	384.20 ± 3.11^{d}	15.65 ± 0.09^{e}
PSRF	465.50 ± 0.04^{a}	24.03 ± 0.08^{a}
SPBF	438.55 ± 0.26^{b}	17.24 ± 0.06^{d}
SPSF	412.16 ± 0.69^{c}	20.40 ± 0.28^{b}

Mean scores having the same alphabet along the same column are not significantly ($p<0.05$) different; values are mean ± standard deviation of duplicate determinations.

The results of the vitamin C content of the sweet potato flour samples varied significantly ($p<.05$) among the flour samples, ranging between 13.00 – 24.03 mg/100 g. The highest vitamin C content was recorded for sample PSRF (Untreated purple fleshed sweet potato flour) (24.03 mg/100 g), while the lowest value occurred in BSCF (Blanched cream fleshed sweet potato flour) (13.00 mg/100 g). The samples indicated significance difference ($p<.05$) between one another. Vitamin C is highly sensitive to heat, oxygen, moisture, and processing conditions, making it particularly susceptible to degradation during food preparation (Vergun et al., 2020). The significantly lower vitamin C content observed in blanched samples indicates substantial losses resulting from thermal processing. During blanching, vitamin C may be destroyed by oxidation or leached into processing water because of its water-soluble nature. The higher vitamin C retention observed in sulphited samples compared to blanched samples may be attributed to the antioxidant properties of sulphite compounds, which help protect ascorbic acid from oxidation during processing and storage. However, untreated samples still exhibited superior vitamin C levels, indicating that processing inevitably results in some nutrient losses. The vitamin C content obtained in this study agreed with reports of Laurie et al. (2022), who recorded vitamin C contents between 12.00 – 26.00 mg/100 g in sweet potato flour. Similar findings (14.50 – 25.30 mg/100 g) were also reported by Sun et al.

(2023) in processed sweet potato products. Motsa et al. (2024) reported that untreated sweet potato flour retained significantly higher vitamin C levels than thermally processed samples. The superior vitamin C content observed in PSRF (untreated purple-fleshed sweet potato flour) further highlights the nutritional advantages of purple-fleshed sweet potato flour. The combined presence of vitamin C and natural antioxidant pigments such as anthocyanins may enhance the antioxidant capacity of purple-fleshed sweet potato products and improve their functional food potential.

CONCLUSION AND RECOMMENDATION

Conclusion

This study showed that sweet potato variety and processing methods significantly influenced the quality of sweet potato flour. Sulphited purple-fleshed sweet potato flour (SPSF) exhibited superior functional properties, including the highest water absorption capacity, oil absorption capacity, swelling capacity, and dispersibility, indicating its suitability for food formulations requiring enhanced hydration and reconstitution characteristics. Untreated purple-fleshed sweet potato flour (PSRF) showed the pasting properties. Colour analysis revealed that sulphiting improved flour lightness, while purple-fleshed samples retained characteristic red-purple pigments. Sample PSRF had the highest protein, fat, fibre, magnesium, iron, potassium, phosphorus, vitamin A, and vitamin C contents, indicating superior nutritional quality. Sample SPSF, however, recorded the highest calcium content and lowest moisture content, suggesting improved mineral composition. Overall, purple-fleshed sweet potato flour, particularly the untreated and sulphited forms, exhibited better nutritional and functional qualities than cream-fleshed sweet potato flour and possesses considerable potential for use in functional foods, bakery products, complementary foods, and composite flour formulations.

Recommendations

Purple-fleshed sweet potato flour should be actively promoted and utilized in the food industry as a nutrient-dense ingredient, particularly in composite flour systems for bakery, infant, and convenience foods, due to its superior protein, fibre, mineral, and vitamin content, while sulphited processing should be adopted where improved functional properties, colour stability, and storage life are required to enhance product quality and commercial usability.

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