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EVALUATION OF BREAD MADE FROM WHEAT AND COMPOSITE FLOURS OF SWEET POTATO

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Abstract: Sweet potato (SP) flour is rich in health-promoting compounds that can improve the nutritional benefits of baked products such as bread when blended with wheat flour. However, the flour particle size and blend proportion may affect the quality properties and consumer acceptability of bakery products. This study evaluates bread made from wheat and composite flour of sweet potato in different proportions of Sweet potato: wheat (25:75, 50:50, 75:25, and 100) various analyses were carried out, such as proximate composition, functional properties of the bread and sensory properties. Results showed that proximate analysis, Mineral and Vitamin composition and sensory evaluation of the bread were significantly higher in the composite flours than in 75:25 sweet potato and wheat flour. However, incorporating sweet potato flour resulted in a significant decrease in breakdown value. Composite flours produced protein-enriched bread with improved essential amino acids exceeding WHO/FAO reference for adults. Composite flours from blends of whole wheat, and sweet potato flours may serve as a potential raw material suitable for the production of nutritious and functional bread products. The present study confirmed effective supplementation the of wheat flour with tuber flour. Composite flours showed improved functional, sensory and physical properties; thus, it may be suitable for the production of baked products such as bread and biscuits.

Keywords: Bread, Sweet Potato, Wheat flour, Orgnoleptic, Physical properties

Background of the study

Bread is a fermented baked product obtained from wheat flour, water, yeast, and salt through mixing, kneading, proofing, shaping, and baking. Wheat flour is one of the vital ingredients in bread production due to its gluten content. Gluten is classically defined as the largely (Gil-Cardoso et al., 2021; Hu, Cheng, Hong, Li, et al., 2021; JI et al., 2019) proteinaceous mass which remains when a dough made from wheat flour and water is gently washed in an excess of water or dilute salt solution to remove most of the starch and soluble material. Wheat is a temperate crop and will not thrive under tropical conditions. Nigeria and many other developing nations (majorly in the tropics) have to import wheat or wheat flour to meet their confectionary needs. (Hu, Cheng, Hong, & Li, 2021; JI et al., 2019; millets, 2019)

Root and tuber crops are essential sources of dietary fibre. Dietary fibre has been associated with beneficial attributes such as improving bulk motility, decreasing blood cholesterol and glucose reduced risks of obesity, type 2 diabetes and cardiovascular disease, Eliminating constipation, acting as a prebiotic, and preventing some types of cancer.(Akhtar et al., 2021; Khalid & Arshad, 2022)

Sweet potato (*Ipomoea batatas*), a dicotyledonous plant, belongs to the **bindweed,** *Convolvulaceae*.(Khalid & Arshad, 2022; Magaji & Journal, 2020; RA et al., 2020) It is an important food crop of the tropics with the potential to alleviate food insecurity and improve nutrition and the economy of many African countries, including Nigeria.(Otekunrin et al., 2019) It is an essential alternative source of carbohydrates and attains fourth place after rice, corn and cassava. Sweet potato flour has been reported as a source of energy and carbohydrates, beta carotene (pro-Vitamin A), Vitamin C, Vitamin B6, minerals (calcium, phosphorus, iron, manganese and potassium) and dietary fibre, and can add natural sweetness, colour and flavour to processed food products Sweet potato is an underutilized crop; however, its flour is used in industrial productions

Therefore, using sweet potato as a partial or whole replacement for flour will reduce dependence on wheat flour for bread production. This research work seeks to **e**valuate the nutrient content, organoleptic properties and acceptability of bread made from wheat and composite flours (Sweet potatoes flour)

Due to rapid rural-urban migration, several urban dwellers depended on ready-to-eat food to satisfy their food requirements. In this regard, ready-to-eat food (RTE) refers to food that could be eaten as purchased and does not require further significant processing other than reheating or completion of a cooking process.

One of the readily available RTE food is bread, which is a staple food that does not require further processing before consumption. It is produced in various forms and eaten in homes, restaurants and hotels in Nigeria. In addition, the consumption of bread cuts across socio-cultural and religious barriers and is a food of choice for both the rich and poor in Nigeria (NAFDAC, 2010).

Baking is the last operation in bread production, where, by the action of heat, the dough is transformed into bread by firming (stabilization of the structure) and by forming characteristic aromatic substances.(Bou-Orm & Jury, 2021; Dong & Karboune, 2021) In bread, it is achieved at baking temperatures around 220- 250oC, although the centre temperature of the loaf reaches only 92-96oC, which is accepted as being necessary for an adequate rigid structure throughout the loaf, due partly to the loss of water.

The dough undergoes a series of changes due to the rise in temperature while it is in the oven. Initially, yeast activity ceases when a temperature of 55o C is reached. Subsequently, the stability of the structure is sustained due to the expansion of entrapped gas. As the temperature nears 60o C, the starch starts to gelatinize. The starch granule first absorbs any free water from the dough and later from the protein membranes until it is fully gelatinized. A final internal temperature in the range of 92-96o C should be achieved for an adequately baked loaf.(Labuza & Altunakar, 2020; Sahin et al., 2019)

Composite flour technology is viewed as the process of mixing a proportion of two or more flours (grains, tuberous plants or legumes) with or without wheat flour to produce bread with desired quality attributes that is referred to as composite bread. Composite flour has been used in developing countries since the1960, where wheat does not grow due to the unfavourable agronomic conditions.

The majority of the populace consumes bread as a staple food, wheat is a major ingredient in bread production, Foreign exchange and importation difficulty often lead to sporadic scarcities of wheat. Various proportions of sweet potato flour can be used with wheat flour to improve nutritive values in terms of fibre and carotenoids. It can also be used to lower the gluten level that can cause coeliac disease Wheat, which is a major ingredient in bread production, is primarily imported into Nigeria, involving the vast expenditure of foreign exchange, thus leading to the high-cost production of bread which may not be affordable by the low-income earner. Potato flour may offer a suitable alternative to those who suffer from gluten allergy from wheat bread. Adopting this new flour will help reduce post-harvest losses of Sweet potatoes by converting it to flour and using it in baking. The research will encourage the utilization of locally available crops in bread production and help minimize the high cost of importation of wheat flour and reduce the allergic consequence of gluten.

MATERIALS AND METHODS

Source of raw materials

Raw materials needed wheat flour, sweet potato, baker's yeast (*Saccharomyces cerevisiae*), sugar and butter) were purchased from the Oje market in Pamo-Isin. Kwara State. They will be taken to the Nutrition and Dietetics Department Federal Polytechnic Ede laboratory for immediate use and processing.

Study Design

An experimental study design in a completely randomized design (CRD)

Bread Production

Baker's yeast was added to composite flour and it was allowed to set for 10 minutes until frothy with bubbles while yeast is activating, combine both flour and salt into a large bowl and hand whisk it together, and add melted butter to the yeast, mixture gradually to form dough once the flour is incorporated. When the dough has started to form, beat the dough. The dough should not be dry or super sticky. It should feel tacky when tapped with a fingertip and just slightly stick to your skin divide the transfer dough into 3 by using a weighing scale 225g egg take each half of the dough and roll it out into a rectangle. The rectangle will be thick and not longer than the length of your loaf pan next, roll the rectangle long side inwardly like a Pelly roll to form long gently closed seams on the end and place the long seam side down into the bottom of the pan the dough will look like a little fat 10g laying in the centre of each pan cover your loaf pans loosely with a tea towel and let rest for rising for 30-45mins (should be kept in a warm place) once risen, remove towel and bake loaves Preheat oven to 400f(204oC) place loaves in the middle to middle lowest rack in the oven and bake for 25-30mins until top is golden brown remove pans from oven and place in the cooler rack for 10-15mins apply butter on top.(Cappelli & Bettaccini, 2020; Formentini et al., 2022)

Table 1: Proportion of composite flour with sweet potato **and wheat flour.**

Samples		Components	Blending ratio (%)
I.	WF	Wheat flour	100
II.	SPWF	Sweet potato: wheat	25:75
III.	SPWF	Sweet potato: wheat	50:50
IV.	SPWF	Sweet potato: wheat	75:25
V.	SP	Sweet potato flour	100

Sample A: WF (Wheat flour); Sample B: SPWF (Sweet potato flour and wheat flour); Sample C: SPWF (Sweet potato flour and Wheat flour); Sample D: SPWF (Sweet potato flour and wheat flour); Sample E: SP (Sweet potato).

Bread making

The preparation of the bread involves the replacement of part of the Wheat Flour (WF) with 25, 50, 75, and 100% sweet poatato flour. The 100% wheat bread served as control. Baking was carried out on the blends using standard bread baking procedures established for the straight dough as reported by (Beghin et al., 2022; Morris, 2021). The formula and baking conditions are given in (Table 2). After mixing, the dough was covered to proof for about 30 minutes and it was kneaded, moulded, placed into a greased pan left to proof for another 2 hours, and finally baked at 180oC for 25-30 minutes in an electric oven. The loaves were then taken out of the tins, and cooled at ambient temperature for 30 minutes. The preparation of the bread involves the replacement of part of the Wheat Flour (WF) with 25, 50, 75, and 100% sweet potato flour. The 100% wheat bread served as control. Baking was carried out on the blends using standard bread baking procedures established for the straight dough as reported by (Beghin et al., 2022; Cappelli & Bettaccini, 2020; Morris, 2021).

Determination of Proximate composition

The proximate composition of the Bread samples will be determined by the standard methods described by the AOAC 2020. The samples will be analyzed for moisture, ash, crude fibre, crude protein, crude fat and carbohydrate.(Dhillon et al., 2020; Malavi et al., 2022)

Functional Properties of Bread

Water Absorption Capacity, Oil Absorption Capacity, Bulk density, swelling capacity and Swelling Index will be determined using the method of (Ofori & Tortoe, 2020).

Evaluation of the Sensory properties

Coded samples of produced bread were served to an untrained panel of 20 judges consisting of students of the Nutrition and Dietetic Department Lead City University Ibadan The panellists will be educated on the respective descriptive terms of the sensory scales and requested to evaluate the various bread samples for taste, appearance, texture, aroma and overall acceptability using a 9-point Hedonic scale. Presentation of coded samples will be done randomly and portable water will be provided for rinsing of mouth in between the respective evaluations

Statistical Analyses

Data generated from the respective analyses will be compiled appropriately. Mean scores will be statistically analysed using Analysis of Variance. Mean separation for sensory results will be done using Fischer's least significance difference test

RESULTS

Proximate composition of bread samples

SAMPLES	MOISTURE Mean±SD	FAT Mean±SD	PROTEIN Mean±SD	FIBRE Mean±SD	ASH Mean±SD	CHO Mean±SD	ENERGY Mean±SD
A	23.50±1.00^{a}	3.00±1.00^{b}	12.17±0.04^{e}	0.92±0.00^{c}	2.33±0.58^{b}	58.08±1.11^{b}	307.99±10.10^{b}
B	28.00±0.50^{b}	5.00±0.00^{c}	9.19±0.04^{d}	1.11±0.01^{e}	1.57± 0.12^{ab}	55.12±0.55^{a}	302.26±2.07^{b}
C	24.17±1.04^{a}	4.33±0.58^{bc}	8.98±0.04^{c}	1.09±0.01^{d}	1.43±0.12^{a}	60.00±0.47^{b}	314.90±6.82^{b}
D	30.83±1.44^{c}	1.00±0.00^{a}	7.27±0.04^{b}	0.88±0.01^{b}	1.40±0.36^{a}	58.62±1.37^{b}	272.53±5.59^{a}
E	27.50±0.50^{b}	4.00±1.00^{bc}	6.83±0.04^{a}	0.83±0.01^{a}	2.40±0.17^{b}	58.44±1.00^{b}	297.08±6.45^{b}

A- 100% wheat flour, B- 75% wheat flour and 25% sweet potato flour, C- 50% wheat flour and 50% potato flour, D- 25% wheat flour and 75% potato flour, Sample E – 100% sweet potato flour; Mean values with the same superscript within the same column are not significantly different (p>0.05). CHO- carbohydrate; energy – Kcal/100g

The proximate composition of bread samples are presented in Table 4.1. The moisture content in bread samples ranged between 23.50% and 30.83% and the moisture content of samples B and E and samples A and C did not differ significantly (p>0.05). Sample D had the highest moisture content (30.83±1.44%) and lowest fat content (1.00±0.00%) which are both statistically significant (p<0.05). There are significant differences (P<0.05) in the protein and fibre content of samples ranging from 6.83% - 12.17% and 0.83% - 1.11% (P<0.05). Sample B had the highest protein (9.19%) and fibre (1.11%) content among all samples. Although Sample C had the highest carbohydrate (60.00%) and energy (314.90Kcal/100g) content, it was not found to be statistically significant (P>0.05).

Mineral composition of bread samples

Samples	Potassium Mean±SD	Sodium Mean±SD	Iron Mean±SD	Phosphorus Mean±SD	Copper Mean±SD	Zinc Mean±SD
A	173.05±0.00^{c}	166.01±0.00^{a}	4.88±0.55^{a}	190.00±5.00^{ab}	0.08±0.00^{a}	0.40±0.00^{a}
B	158.68±5.59^{b}	514.64±34.86^{c}	4.17±0.55^{a}	183.99±289^{ab}	0.13±0.00^{b}	1.56±0.06^{c}
C	102.77±5.59^{a}	305.46±0.00^{b}	4.46±0.31^{a}	178.33±2.89^{a}	0.08±0.00^{a}	1.01±0.06^{b}
D	171.72±3.23^{c}	584.36±34.86^{c}	3.99±0.21^{a}	190.00±5.00^{ab}	0.14±0.00^{c}	1.69±0.03^{d}
E	225.77±0.00^{e}	688.95±34.86^{d}	4.70±0.10^{a}	196.67±7.64^{b}	0.19±0.00^{d}	2.22±0.00^{e}

A- 100% wheat flour, B- 75% wheat flour and 25% sweet potato flour, C- 50% wheat flour and 50% potato flour, D- 25% wheat flour and 75% potato flour, Sample E – 100% sweet potato flour; Mean values with the same superscript within the same column are not significantly different (p>0.05).

Table 4.2 shows the mineral composition of the bread samples. Sample E had the highest potassium (225.77±0.00mg/100g), sodium (688.95±34.86mg/100g), copper (0.19±0.00mg/100g) and zinc (2.22±0.00mg/100g) contents, all of which are significantly different (p<0.05). The iron and phosphorus contents of the samples did not differ significantly (p>0.05) and ranged from 3.99mg/100g to 4.70mg/100g and 178.33mg/100g to 196.67mg/100g respectively.

Vitamin composition of bread samples

Samples	Vitamin A Mean±SD	Vitamin B1 Mean±SD	Vitamin B3 Mean±SD	Vitamin B6 Mean±SD	Vitamin B9 Mean±SD	Vitamin D Mean±SD	Vitamin E Mean±SD
A	0.04±0.00^{a}	0.16±0.00^{a}	0.14±0.03^{ab}	0.43±0.05^{b}	0.14±0.00^{a}	0.03±0.00^{c}	0.19+0.00^{a}
B	0.06±0.00^{c}	0.16±0.00^{a}	0.16±0.00^{b}	0.25±0.05^{a}	0.34±0.03^{b}	0.02±0.00^{ab}	0.23±0.05^{ab}
C	0.05±0.00^{b}	0.16±0.00^{a}	0.22±0.00^{c}	0.43±0.02^{b}	0.16±0.03^{a}	0.02±0.00^{b}	0.25±0.02^{ab}
D	0.06±0.00^{d}	0.15±0.01^{a}	0.16±0.01^{b}	0.33±0.04^{ba}	0.23±0.12^{ab}	0.02±0.00^{a}	0.24±0.03^{ab}
E	0.07±0.00^{e}	0.16±0.01^{a}	0.11±0.01^{a}	0.31±0.06^{ba}	0.19±0.03^{ab}	0.02±0.00^{a}	0.30±0.01^{b}

A- 100% wheat flour, B- 75% wheat flour and 25% sweet potato flour, C- 50% wheat flour and 50% potato flour, D- 25% wheat flour and 75% potato flour, Sample E – 100% sweet potato flour; Mean values with the same superscript within the same column are not significantly different (p>0.05)

Table 4.3 shows the vitamin composition of the bread samples. Vitamin A was significantly different (p<0.05) among samples with Sample E having the highest content (0.07mg/100g). Samples B (0.16mg/100g) and D (0.16mg/100g) had the highest Vitamin B3 content which was not significantly different (p>0.05). There was no statistically significant difference (p>0.05) between the Vitamin B1, B6, B9, and E contents among samples ranging between 0.15mg/100g - 0,16mg/100g, 0.25mg/100g – 0.43mg/100g, 0.16mg/100g – 0.34mg/100g, and 0.19mg/100g – 0.30mg/100g respectively. Sample A had the highest Vitamin D content (0.03±0.00mg/100g) among all samples and was significantly different (p<0.05).

Physical properties of bread samples

Sample	Loaf weight Mean±SD	Loaf volume Mean±SD	Specific volume Mean±SD
A	130.39±0.00^{a}	360.00±2.00^{a}	2.76±0.02^{a}
B	137.72±0.02^{b}	305.00±5.00^{b}	2.21±0.04^{b}
C	130.14±0.01^{c}	160.67±1.16^{c}	1.23±0.01^{c}
D	140.40±0.01^{d}	193.33±2.89^{d}	1.38±0.02^{d}
E	127.96±0.01^{e}	174.33±2.08^{e}	1.35±0.02^{d}

A- 100% wheat flour, B- 75% wheat flour and 25% sweet potato flour, C- 50% wheat flour and 50% potato flour, D- 25% wheat flour and 75% potato flour, Sample E – 100% sweet potato flour; Mean values with the same superscript within the same column are not significantly different (p>0.05)

Table 4.4 shows the loaf weight, loaf volume and specific volumes of the different bread samples. The mean loaf weight of bread samples ranged from 127.96 to 140.40 and was statistically significant. Similarly, the mean loaf volumes ranged from 160.67 to 360.00 and were statistically significant. On the contrary, mean specific volumes of samples ranged from 1.23 to 2.76 and but the mean specific volumes of samples D and E were not statistically significant.

Sensory evaluation of bread samples

Samples	Colour Mean±SD	Aroma Mean±SD	Texture Mean±SD	Sweetness Mean±SD	Appearance Mean±SD	Overall Acceptability Mean±SD
A	3.00±0.00^{a}	2.14±0.90^{ab}	2.57±0.79^{a}	3.86±1.07^{c}	1.86±1.07^{ab}	4.43±0.79^{b}
B	4.00±0.00^{b}	1.43±0.79^{a}	2.71±0.76^{a}	3.57±0.98^{bc}	1.71±1.11^{a}	3.86±0.69^{b}
C	4.14±0.38^{b}	3.71±1.89^{bc}	2.86±0.90^{a}	2.14±0.90^{ab}	2.86±0.38^{ab}	1.71±0.76^{a}
D	4.29±0.49^{bc}	4.57±1.13^{c}	3.14±1.46^{ab}	1.71±0.49^{a}	2.71±0.49^{ab}	1.43±0.54^{a}
E	4.71±0.49^{c}	5.00±0.00^{c}	4.57±0.54^{b}	3.00±1.41^{abc}	3.14±0.90^{b}	2.14±1.38^{a}

A- 100% wheat flour, B- 75% wheat flour and 25% sweet potato flour, C- 50% wheat flour and 50% potato flour, D- 25% wheat flour and 75% potato flour, Sample E – 100% sweet potato flour; Mean values with the same superscript within the same column are not significantly different (p>0.05)

Table 4.5 shows the mean score of the sensory attributes and overall acceptance of each of the bread formulations. The mean taste, aroma, texture, sweetness, appearance and overall acceptability scores of some of the formulations did not differ significantly across formulations (p>0.05). The posthoc test analysis (Tukey homogenous subsets) was carried out to identify where the significant difference lies.

The colour scores range from 3.00 to 4.71 with sample A recorded to have a golden brown colour (3.00±0.000) which is statistically different from the other samples (P<0.05). The scores showed that the samples were generally brown in colour but sample E tended towards burnt brown (4.71±0.488). The rating of aroma ranged from 1.43 to 5.00. Sample E was considered by the panellist to be choky (5.00±0.000) and Sample B to be between no aroma and slightly perceptible (1.43±0.787). Sample D was considered by panellists to have a soft texture (3.14±1.464) but was not statistically different from other samples (P>0.05). Although not statistically significant (P>0.05), sample E was rated sweet (3.00±1.414) by panellists and sample D as bland (1.71±0.488). Sample E was considered as crusty around the edges (3.14±0.900) by the panellists. Generally, the panellists liked samples A and B but liked sample A more (4.43±0.787).

Discussion

Proximate Composition of Bread Produced from Wheat and sweet potato flour blends. The result obtained from the relative composition of composite bread shows that the protein, ash, and crude fiber contents increased. In contrast, the moisture, crude fat, and carbohydrate decreased with increasing sweet potato flour substitution levels. The decrease in moisture content with an increase in the substitution level shows the certainty of prolonging shelf life. The range of moisture content implied that the sweet potato bread had good storage potential since it was known that the moisture and water activity of the product determine the shelf life of food products. The values were similar to those lower than the values 28.94%-36.95% in 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.

The protein content of the bread decreases significantly (p >0.05) with the decrease in the quantity of sweet potato in the composite bread. Yet the amount of protein present is rich enough to prevent protein-energy malnutrition. The protein content increases since sweet potatoes are reportedly rich in protein and contain all the essential amino acids, especially lysine.(Korese et al., 2021) The values were higher than the findings of previous researchers.(Malavi et al., 2022; Ofori & Tortoe, 2020)

The ash contents give an insight into the amount of inorganic content of the samples where the mineral contents could be obtained. The values obtained for ash content were in the range of 1.52%-1.80%, reported by [3]. The values obtained for ash contents showed that the composite bread could provide essential minerals needed for body metabolism.

The values fiber were higher than values 0.29%-0.59% reported by (Beghin et al., 2022; Cappelli & Bettaccini, 2020). Crude fiber contributes to the health of the gastrointestinal system and the metabolic system in man.(Sahin et al., 2019)

There was a significant increase in carbohydrate content as the substitution level of sweet potato bread increased. The substitution effect might be the primary reason for this observation because sweet potato bread is attributed to high protein content and other constituents. This value is in low agreement with values 52.98%-49.70% reported by(Malavi et al., 2022).

Physical Properties of Bread Produced from Wheat and Lima Beans flour blends.

The loaf weight increases as shown by increasing substitution of the composite flour, and the values ranged from 150.24 g-173.98 g. The observed significant (p>0.05) increase in loaf weight with an increasing amount of sweet potato bread substitution was due to less retention of carbon dioxide gas in the blended dough, hence providing dense bread texture, which goes in line with the values reported by(Olagunju et al., 2020).

The loaf volume and specific volume decreased significantly. The less loaf volume and specific volume of the composite bread were probably due to the dilution effects on gluten by adding sweet potato bread to the wheat bread. This value is similar to values reported by (Formentini et al., 2022) that produced bread from wheat and black sesame flour. The Gluten fraction is responsible for the elasticity of the dough by causing it to extend and trap the carbon dioxide generated by yeast during fermentation (Sahin et al., 2019). When gluten thickens under the influence of heat during baking, it serves as the framework of the loaf, which becomes relatively rigid and does not collapse. The decrease in loaf volume and specific volume could result from the substitution effect, which might have reduced the gluten content in the dough.

The sensory evaluation results of bread samples containing different levels of sweet potato bread substitution compared to the control. The bread colour and crust colour results did not show a consistent pattern for all the bread samples. The mean score for aroma Bread with 25% sweet potato substitution had the highest score in both parameters. This may be due to aromatic compounds in sweet potato—bread texture. The baking conditions (temperature and time variables), the state of the bread components, such as fiber, starch, protein (gluten) and the amounts of absorbed water during dough mixing, all contribute to the final texture of the bread (Korese et al., 2021; Torbica, 2019). On the overall acceptability, the mean score ranged from 3.86, with bread containing 75% sweet potato substitution having the highest score. It was observed that bread substituted with 75% sweet potato was best preferred in all the sensory attributes evaluated.

Minerals and Vitamins Content shows the bread's minerals (Calcium, Iron, Zinc) and vitamins (vitamin A, B, D and E) content. All the minerals and vitamins generally increased with the increased substitution of wheat bread with sweet potato. Sweet potato is rich in nutrients, increasing the micro-nutrient content of zinc, copper and iron (Bou-Orm & Jury, 2021; Ofori & Tortoe, 2020). Calcium is necessary for teeth and bone health, whereas iron is crucial for forming haemoglobin and plays a vital role in the various metabolic processes. Zinc aids in the growth and repair of tissues boosts the immune system and plays a crucial role in sperm survival. (Bou-Orm & Jury, 2021; Dong & Karboune, 2021)

Conclusion

Incorporation of sweet potato as composites for bread production affected the proximate composition, mineral contents, Vitamins content, physical properties and sensory properties of the bread samples. The use of sweet potato improved the nutritional content of the bread samples with respect to their proximate composition. The bread samples containing sweet potato recorded high protein contents which were higher than the 100% wheat bread and the bread samples containing sweet potato recorded high carbohydrate content higher than the 100% wheat bread. This means that sweet potato can be used in composite with wheat for bread production in order to improve the nutritional adequacy of bread and snack foods in general. The mineral composition of the sweet potato bread samples, had the highest-level potassium, sodium, copper and zinc than 100% wheat bread. The iron and phosphorus contents not different from 100% wheat bread. The vitamin composition of sweet potato bread samples had the highest content of Vitamin A, Vitamin B3 content compare to 100% wheat bread which was low. Order vitamins analysed show similarities between sweet potato bread and 100% wheat bread. Such as Vitamin B1, B6, B9, and E contents.

The physical properties of sweet potato bread and 100% wheat bread are similar in loaf weight, loaf volume and specific volumes of the different bread samples Sensory scores showed that the bread samples were acceptable.

5.2 Recommendation

- The use of composite sweet potato as plant products are nutrient dense in the production of snacks like bread should be encouraged as it will help in improving the nutritional adequacy of snacks and also contribute in solving the problem of protein-energy malnutrition that is prevalent in developing countries.
- There should be encouragement in using sweet potato as whole or composite flour for snacks production, so as to reduce post-harvest losses and promote food diversification.
- Further studies should be carried out to determine the shelf stability of the bread.

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