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Determination of Mineral Elements, Vitamins, and *Anti-nutrient* Properties of Biscuits Produced from Sweet Potato, Wheat and Cashew nut Flour

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Abstract

The nutritional qualities of biscuits made with a composite flour made of wheat, sweet potatoes, and cashew nuts were assessed in the study. Different ratios were used to make and combine the flour. The individual samples' vitamin, mineral, and ant nutrient contents measured at some ranges significantly differ (P- >0.05). Mineral concentrations of the samples' varied widely in terms of iron, calcium, and zinc levels. However, sample C had the highest concentrations of zinc, calcium, and iron. The anti-nutrient content of the samples revealed that sample C included the most Tannin, Oxalate, and Phytate, whereas sample A had the lowest anti-nutrient probe result. The trace levels of anti-nutrients discovered in the examined biscuit samples, however, are within the acceptable range for ingestion by humans. The study comes to the conclusion that biscuits prepared from flour mixes of potatoes, wheat, and cashew nuts help prevent malnutrition by meeting the nutritional needs of both adults and children. Wheat flour may benefit from the addition of cashew and potato flour to increase nutritious content. The study recommends more investigation into the biscuit samples' microbial loads.

Keywords: Composite flour, gastronomy, food innovation, human nutrition, organic biscuits

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Introduction

Around the world, biscuits are a cheap, easily consumed dessert that appeals to individuals of all socioeconomic backgrounds. They are baked to perfection in an oven using delicious dough (Omoba & Omogbemile 2013). It can be made with a soft or hard dough that is heavy in fat and carbohydrates. Biscuits are considered a good medium for micro- and macronutrient enrichment and fortification because of their exceptionally low moisture content (Ashworth, 2015). It has been suggested that biscuits are more made into composite flour than bread because they are readily consumable, have a long expiration date, and have a great edibility (Horns, Timpo, and Gruene G., 2007).

Combination of sweet potato and wheat flour **makes** biscuit goods with improved functional qualities, decreased retrog radation, staling rate, and manufacturing time (Adeleke & Odedeji, 2020). Additionally, this contributes to the production of baked goods with greater quality and value. The wheat plant, (*Triticum aestivum*), belongs the grass family Graminae. Among the countries that cultivate wheat are the United States of America, Canada, Australia, Argentina, China, Russia, India, Pakistan, and a few members of the European Union (FAO, 2009). Wheat flour is the principal flour used to make baked goods and a staple in human nutrition. This is due to wheat flour's easy malleability and possession of all the qualities required to be a flour material for baking. Dorothy & Arukwe (2021). However, Nigeria's land and climate are not conducive to growing wheat, and importing the grain is expensive FAO (2009). By adding more sweet potato flour to boost the amount of fiber and carotenoids, the nutritional value of wheat flour can be raised. This helps prevent celiac disease by bringing down the body's sensitivity to gluten (Tilman et al., 2019).

According to Olanyanju et al., (2016), sweet potatoes (*Ipomoea batatas*) contain several antioxidants that may help prevent some malignancies. Purple sweet potatoes contain an antioxidant called anthocyanins, which has been shown in lab tests to inhibit the growth of some cancer cell types, such as stomach, colon, bladder, and breast cancer cells (Adubasim, 2017). Processed foods can be organically sweetened, coloured, and flavoured with sweet potato flour. In addition, it has b-carotene, nutritious fiber, and essential nutrients. Sweet potatoes are rich in fiber, potassium, iron, and vitamins C and E, although they are low in fat and cholesterol (Okaka, 2015). Along with carbohydrates and other nutrients, it provides a substantial amount of protein to a vast number of individuals globally (Zuraida, 2017).

Cashews are a crop that is high in essential fatty acids, micronutrients, phytochemicals, and essential amino acids, according to Okaka (2015). Nuts made from cashews are delicious and adaptable; they can be consumed fresh, crisped, salty, or sugar coated (Manay & Shadaksharaswamy, 1987). Besides, its widely used and comes in a variety of forms, which contributes significantly to the diet's unseen fat content. The demand for cashews has increased in many temperate countries (Russel, 1979). It is thought to have a special economic relevance due to the differences in the economic worth of its constituent parts (Okaka, 2015). Nigeria has become a market for cashew exports because the country's foreign exchange is largely derived from cash crops.

In recent years, Nigerian researchers have worked sincerely and persistently to focus on the use of affordable, easily accessible flours manufactured from local staples to supplement wheat flour in baked goods production. Sweet potatoes and cashew flour can be used with wheat flour while baking and preparing other foods. This will minimize the amount of wheat imported from other nations by using less wheat flour. Moreover, this will local inspire the widespread farming and utilization of staples like cashew nuts and sweet potatoes Arukwe & Dorothy (2021). Given this, the purpose of the current study is to determine which vitamins, minerals, and anti-nutrients are present in biscuits that are created with a composite flour that consists of crushed cashew nuts, sweet potatoes, and wheat.

Materials and Methods

Sayedero Market in Ilaro, Ogun State, Nigeria is where the cashew nuts, wheat flour, and sweet potato tubers were bought. Additional ingredients needed for baking, including butter, eggs, flavourings, milk, binder, salt, and baking powder, were bought at Bola Market Orita in Ilaro, Ogun state, Nigeria.

Specimen Preparation

After the potato skin was removed from the tuber, the edible part was cut into pieces and dried in the oven for 25 minutes at 105 degrees Celsius after being cleaned with clean water. After allowing the dried potatoes to cool, they were ground into fine flour using a hammer mill and then carefully packed for usage. Additionally, cashew nuts were bought and mixed to ensure consistency. Before production, wheat flour was bought and securely kept in an airtight container.

Ayo (2018)'s recipe method for making biscuits was used with a few minor changes. Every item that was specified to be used in the biscuit was measured and weighed incorrectly. To make a dough, the wet ingredients were added and properly mixed with the dry ingredients. After kneading, the dough was flattened out with a rolling pin and finely shaped. After preheating the oven, the biscuits were baked for one and a half hours. The biscuit was baked, cooled, and then packaged.

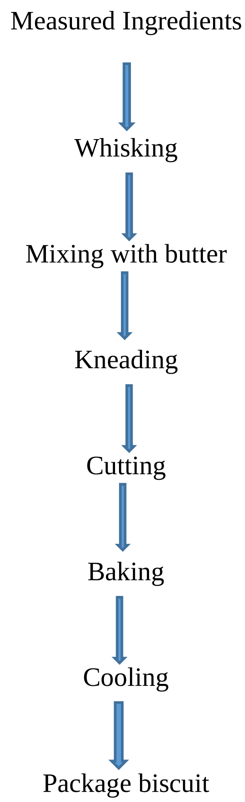

Figure 1: shows the process flow chart of biscuit production (Ayo, 2018).

Proportions Ratio

Formation of blends of wheat powder, sweet potato powder, and cashew nut

Specimen A: 100% Wheat powder (used as control)

Specimen B: 85%Wheat powder, 10%sweet potato powder, and 5%crushed cashew nut

Specimen C: 70%Wheat powder, 25%sweet potato powder and 5%crushed cashew nut

Specimen D: 50%Wheat powder, 35%sweet potato powder and 5%crushed cashew nut

Determination of Vitamin A and D

Vitamins A and D levels were discovered using the procedure reported by Achikanu et al. (2013). After weighing out 2g of the substance, it was soaked in a test tube with 20 ml of n-hexane for 10 minutes, and then it was extracted for 10 minutes. Following the filtering of the mixture 3 ml of the drain was added to each dry test tube, and three test tubes were dried in triplicate in a boiling water hot tub. Subsequently, 2 ml of 0.5N alcoholic potassium hydroxide was added, and the blend was placed in a hot tub to boil for 30 minutes. Next, 3 ml of n-hexane was added and given a good shake. The n-hexane was moved to another set of test tubes and allowed to dry.

Determination of Vitamin C

Josiah and Okwu's (2006) methodology was applied. After 30 minutes of mixing, 100 ml of the EDTA/TCA (2:1) distilling suspension was added to an extraction tube holding 5g of the material. Following that, it was placed in a extractor tube and rotated for around 20 minutes at 3000 rpm. Once the 100 ml volumetric flask was filled to the brim, the extracting solution was added. To create a dark endpoint, twenty millilitres of the extract and one percent starch indicator were added to the volumetric flask, and the mixture was titrated with a 20% CuSO4 solution.

Ant- Nutritional Analysis

Determination of Oxalate

Day and Underwood (1986) gave the procedure for estimating oxalate. 1 g of the material was measured into a 100 ml flask with 75 ml 3N H2SO4 and swirled periodically for an hour with a magnetic agitator. The water was then strained with Whatman No. 1 filter paper. 25 ml of the drain was obtained and calibrated against 0.1N KMnO4 solution while it was heated (80-90 °C) for at least 30 seconds.

Oxalate content = $T \times (Vme)(Df) \times 10^5 \Big/ ME \times Mf$ mg/100g

T= titer of $KMnO_4$ (ml), Vme = volume-mass equivalent, Df = dilution factor, $V_{T/}A$ (2.4 where V_T is the total volume of titrate and A is the aliquot used, ME is the molar equivalent of $KMnO_4$ in oxalate, M_f = mass of flour.

Analysis of Phytate

Maga (1982) provided a phytate measurement method. Each sample was steeped in 20 cc of 0.2 N HCl for three hours before filtering. After filtering, 1 ml of ferric ammonium sulphate solution and 0.5 ml of the filtrate were combined in a flagon. After that, the tube was heated for 30 minutes in a hot tub, cooled for 15 minutes in ice, and then centrifuged for 15 minutes at 3000 rpm. After combining 1.5 ml of 2, 2-pyridine solution with one ml of supernatant, the absorbance at 519 nm was measured using a spectrophotometer. The cluster of phytic acid was calculated by extrapolating from a standard curve and using a standard phytic acid mixture.

Analysis of Tannins

Tannin content was discovered using the technique proposed by Swain (1979). After measuring each sample into a 50 ml beaker, addition of 20 ml of 50% methanol was made. The sample was enveloped with paraffin and then heated to 77–80 C in a hot tub for an hour. A glass rod was used to agitate the sample to avert aggregating. The extract was quantifiably strained into a 100 ml flask using a dual film strained paper, and it was then washed with 50% methanol. One ml of the sample extract, twenty of distilled water, 2.5 ml of Folin-Denis reagent, and ten ml of 17% Na2C03 were pipetted into a 50ml volumetric flask after this was well mixed with distilled water. The mixture was entirely mixed with distilled water and then permitted to stand for 20 minutes to acquire a bluish-green colouring. Standard tannic acid mixtures in the 0–10 ppm range were treated using same methods as for the 1 ml sample mentioned earlier. Absorbance of the samples was measured using a Spectronic 21D Spectrophotometer and standard solutions containing tannic acid at 760 nm following colour development. The proportion of tannin was estimated with the formula below:

$$\text{Tannin (\%)} = \frac{\text{Absorbance of sample X Average gradient X Dilution factor}}{\text{weight of sample X 10,000}}$$

Mineral Analysis

The AOAC (2000) method was used to assess the samples' mineral content. Zinc and iron elements were examined using an Atomic Absorption Spectrophotometer (Thermo Scientific S Series Model GE 712354) following digestion with a solution of perchloric and nitric acid (AOAC, 2000). Prior to digestion, a fume hood was used to weigh 0.50 g of each sample into a 125 ml Erlenmeyer flask and combine it with 4 ml of perchloric acid, 25 ml of concentrated HNO3, and 2 ml of undiluted sulfuric acid. Under a perchloric acid fume hood, the contents were slowly prepared on a heated plate over little to average heat in an autoclave (Buchi Digestion unit K-424) until a dense white fume formed. After applying intense heat for 30 seconds, the mixture was allowed to cool before 50 cc of pure water was added. The mixture was permitted to cool before being fully strained through a clean bottle and placed into a Pyrex flask with the inclusion of distilled water. Afterwards, the mixture was measured with Atomic Absorption Spectrophotometer.

Results

Vitamin and Mineral Content of the Biscuit Samples

Vitamin and mineral constituents of the biscuit sample is displayed in Table 1. The mean value of vitamin A varies between 0.78 and 0.95 mg, with sample D exhibiting the most mean value. Sample B has the greatest mean score for vitamin C, with a mean value ranging from 0.37 mg to 0.85 mg. Additionally, Sample D had highest mean outcome for vitamin D, with a mean value ranging from 0.10 mg to 0.21 mg. The samples' mean scores for iron, calcium, and zinc varied from 1.36 mg to 1.56 mg, 14.52 mg to 16.92 mg, and 0.27 mg to 0.49 mg, respectively. Among the three minerals tested in this investigation, Sample C had the highest mean score. Mineral samples exhibit substantial differences (P <0.05).

Table 1: Vitamin and Mineral Constituent of the Cookies Specimen

Specimens	Vita min A (µg/ 1oog)	Vitamin C (mg/100g)	Vitamin D (µg/ 1oog)	Iron (mg/100g)	Calcium (mg) /100g	Zinc (mg/100g)
A	$0.79±0.12^{a}$	$0.43±0.02^{a}$	$0.14±0.02^{ab}$	$1.50±0.02^{cd}$	$16.08±0.04^{c}$	$0.30±0.01^{a}$
B	$0. 78±0.21^{a}$	$0.85±0.04^{d}$	$0.10±0.01^{a}$	$1.36±0.04^{a}$	$14.52±0.03^{a}$	$0.27±0.21^{a}$
C	$0.82±0.02^{ab}$	$0.37±0.02^{a}$	$0.16±0.02^{bc}$	$1.56±0.02^{d}$	$17.15±0.04^{e}$	$0.49±0.02^{c}$
D	$0.95±0.28^{ab}$	$0.57±0.02^{b}$	$0.21±0.02^{cd}$	$1.48±0.02^{bc}$	$16.92±0.03^{d}$	$0.38±0.02^{b}$

*Values with different superscripts show that there is a significant difference (P- <0.05).

Anti-Nutrients Constituent of the Cookies Specimens

Table 2 shows the anti-nutrient Constituent of the cookies Specimens. Tannin, oxalate, and phytate, mean values range from 0.03mg to 0.05mg, 0.03 mg to 0.41 mg, and 0.03 mg to 0.04 mg respectively. Sample C had the highest anti-nutrient content of all the samples probed. However, the ant-nutrient contents of the biscuit formulation blends examined in the present study significantly differ (P <0.05).

Table 2: Ant nutrients Constituent found in the Cookies Specimens

Specimens	Tannin (mg)	Oxalate (mg)	Phytate (mg)
A	$0.03±0.00^{a}$	$0.03±0.00^{a}$	$0.03±0.00^{a}$
B	$0.04±0.00^{b}$	$0.31±0.00^{b}$	$0.03±0.00^{b}$
C	$0.05±0.00^{e}$	$0.41±0.00^{e}$	$0.04±0.00^{d}$
D	$0.05±0.00^{d}$	$0.04±0.00^{d}$	$0.03±0.00^{c}$

*Values with different superscripts show that there is a significant difference (P- <0.05).

Discussion

Of all the biscuits, Sample D has the highest Vitamin A concentration, ranging from 0.78 to 0.95µg/100g. Nonetheless, the vitamin A content was lower than that of baked items or snacks that were ready to eat, which ranged from 2.42 to 6.01µg/g according to Okafor & Ugwu (2014). For the development of bones, cell division, differentiation, reproduction, and eyesight, vitamin A is essential (David & Joseph, 2018). There was no significant difference (P>0.05) in vitamin A between samples C and D or between samples A and B, the control sample.

As regards vitamin C, sample B has the greatest mean value, ranging from 0.37 to 0.85 mg/100 g. This is less than the findings of a study on the proximate, vitamin, mineral, and anti-nutrient composition of bread made from blends of African yam bean (Sphenostylis stenocardia) and maize (Zea mays) seed powder, which was carried out by Henry-Unaeze, & Amadi (2022), and which discovered that the highest mean value for vitamin C was 41.76 mg. But the reason for this rise is that African yam beans were added to the sample. When it came to vitamin C, Sample C and Sample A, the baseline sample, did not significantly differ (P>0.05); however, Sample B and D significantly (P<0.05) differ.

Mineral contents of sample C have the most concentration of iron, calcium, and zinc (ranges from 1.36 to 1.56 mg, 16.08 to 17.15 mg, and 0.30 to 0.49 mg/100 g, correspondingly). The present findings corroborate the research conducted by Isah et al. (2022), which observed that the iron constituent of wheat biscuits rose from 39.14 mg/kg to 54.30 mg/kg upon the addition of aubergine. The inclusion of aubergine in the composite biscuit resulted in a higher iron content. Iron is the primary building block of hemoglobin, which carries oxygen throughout the body. Furthermore, iron is necessary for cells' oxygen cell function (Islamiyat et al., 2016). Emelike et al. (2015) observed that cashew nuts are a very good origin of minerals like calcium and can be employed as a functional element in snack goods. The high calcium content of the composite biscuit supports this finding. Not only does calcium aid in the formation of bones, it also keeps the heart and muscles healthy. On the other hand, the iron, calcium, and zinc constituents of the biscuit samples revealed a noteworthy variation. The cookies' anti-nutrient levels ranged from 0.03 to 0.05 mg for tannin, oxalate, and phytate, respectively.

However, there was a notetable difference (P<0.05) between the anti-nutrient in the control sample and the other biscuit samples. Majority of anti-nutrients are substances, natural or synthetic, that prevent the body's capacity to digest, utilize nutrients, and may have other unfavourable consequences. Ratta & Gemede (2014). The fact that the biscuit samples were all processed may have contributed to the fact that their anti-nutrient concentrations are all within the safe range recommended for human consumption. It is first recommended to treat food appropriately in order to minimize ant nutritional components, even if human susceptibility to ant nutrients varies widely (Soetan & Oyewole 2009). However, these drugs can also help people if they are used sensibly.

Conclusion

The study concludes that biscuits high in micronutrients can be made using blends of potato, wheat, and cashew nut flour, which can help avoid malnutrition in both adults and children. One effective method of increasing nutritional intake is to combine potato and cashew flour with wheat flour.

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