Effect of partial substitution of wheat with water yam and peanut skin flour in cake making

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ABSTRACT

The aim of the study was to evaluate the nutritional compositions, functional properties and sensory evaluation of cake samples made with wheat, water yam and peanut skin blended flour. The flour samples were blended into different proportions of 100:0:0, 90:6:4, 80:15:5, 70:20:10 and 60:25:15.The nine-point hedonic scale was employed for sensory evaluation using 50 semi-trained panellists. Proximate composition analysis revealed a significant impact ($p<0.05$) on fibre, protein and carbohydrate. With increasing substitution, the amounts of moisture, ash and fat decreased and varied from 17.50-11.79%, 1.50-1.12% and 19.70-12.52% respectively. Functional properties decreased with the exception of oil absorption capacity as the substitution increased and ranged from 170.00-100.25%, 0.70-0.66% and 1.60- 1.38% respectively. The taste, flavour, colour, texture and overall acceptance of the various cake samples were assessed, and the findings revealed that the majority of the panellists liked the cake sample made with 80% wheat, 15% water yam and 5% peanut skin blended flour. The study's findings indicated that water yam and peanut flour could be used to make composite flour that is of excellent quality and acceptable, which can be used to make cakes and pastry products to reduce the importation of wheat flour.

Keywords: composite flour, proximate composition, functional properties, peanut skin, cake

INTRODUCTION

One of the most significant crops produced globally is wheat (Triticum aestivum). Because of how easily it can be handled, it is frequently transformed into a variety of delicacies for human consumption (Lance and Garren, 2002). Wheat flour is an excellent choice for making bread, cakes, and other yeasted items due to its high gluten concentration (Dvorak, 2009). Cakes are soft baked goods that are made by baking a batter using flour, baking powder, and beaten eggs, with or without shortening (Zambrano, Desinoy, Ormenese & Faria, 2014). Cakes are a popular fast-food snack and the focal point of numerous events. Cakes are often made with wheat flour, sugar, eggs, and baking powder. It is a full-spectrum food that is high in fat and protein. There are literally millions of different cake recipes, which can be categorised according to their accompaniment, such as coffee cakes or occasion cakes, or based largely on ingredients and cooking methods (Eke, Achinewhu & Sanni, 2008).

Yams provide more than 200 daily calories per person for more than 150 million people in West Africa. Furthermore, they are a significant source of income (Abiodun and Akinoso 2014). Africa, especially West Africa, is the world's largest producer of yams, accounting for over 90% of global production (ITTA 2009). Yams are the third-most important tropical root crop after cassava and sweet potato (Onyeka et al., 2006), and they represent a significant source of carbohydrates for many people in the sub-Saharan region, particularly in the yam zone in West Africa. In Western and Central Africa, boiling, frying, and roasting are the most popular ways to prepare white yam. Yam flour is a finely ground product derived from the yam tuber. When reconstituted, it serves as the main component in the production of "Konkonte" in Ghana and "Amala" in Nigeria (Akissoe et al., 2003). In comparison to raw tubers, processed yam flours are less bulky, less delicate to handle and store, and less prone to storage losses (Ezeocha et al., 2014). While Adejumo et al. (2013) investigated the quality characteristics of yam flour (Elubo) as influenced by blanching water temperature and soaking time, Abiodun & Akinso (2014) investigated the influence of soaking method on the chemical and functional qualities of Trifoliate yam (Discorea Dumentorium). The water yam tuber includes important nutrient sources such as carbohydrate, protein, lipids, vitamins, and other nutrients (Ogidi, Wariboko, & Alamene, 2017). As a result, water yam can serve as both a dependable staple food and a food source substitute. Water yams can also be used for a variety of other purposes that can be developed in the industrial sector, such as cosmetics and medicine (Chandrasekara & Kumar, 2016).

One of the nuts that are grown extensively over the world is the peanut. Most of the time, peanut skin is dumped as waste from the industry that processes peanuts; only a small amount is used to manufacture cow feed (Sobolev and Cole, 2004). The peanut (Arachis hypogaea L.) fruit (pod, nut) is made of an external shell (or hull) (21-29%), the nut itself (79-71%), the kernel (69-73%), the germ (2.0-3.5%), and an enclosing thin hull (testa or seed coat), which is typically paper-like and coloured and is more commonly known as the peanut skin (Davis et al., 2016). The blanching procedure results in the removal of the skin using peelers, which feature rollers covered in abrasive material to facilitate the removal of the skin. At specialised facilities, blanching is frequently used to prepare peanuts for the production of snack foods, peanut butter, and other foods containing peanuts (Hill, 2002). Peanut skin has 12% protein, 16% fat, and 72% carbohydrates. This combination yields 140–150 mg of phenolic chemicals per gramme of dry skin (Sobolev and Cole, 2004). For use in food and dietary supplements, the skin may offer a low-cost source of natural antioxidants such as catechins and procyanidin (Ahmedna and

Goketpe, 2006). The nation's health can benefit from using peanut skins as a cheap source of polyphenols for nutritional supplements or as functional additives in foods (Zhao et al., 2012).
People seem to be converting to wheat-free diets at an increasing rate for valid reasons. Although wheat is used to make a variety of items, such as biscuits, bread, cakes, pasta, bagels, cereals, and semolina, its nutritional worth is debatable. The negative consequences of gluten, which is found in wheat, are significant and include fatigue, bloating, constipation, diarrhoea, weight loss, intestinal damage, osteoporosis, and anaemia. Due to its high cost and importation, wheat is out of the grasp of most people, who are into baking. Yet, studies have shown that locally available foods such as water yam and peanut peel, which contain soluble fibres, can reduce bile acid absorption, reabsorb bile acids, and enhance faecal excretion while also hastening the conversion of hepatic cholesterol into bile salts (Yu et al., 2015).

As part of a food-based strategy to meet nutritional, mineral, and micronutrient requirements, water yam and peanut skin are anticipated to contribute to the food diversification and diet diversity that have been widely acknowledged and advocated as essential elements of healthy diets on an international scale (Dwivedi et al., 2017). Also, compared to food fortification and supplementation, food diversification and diet diversity are thought to be more effective and long-lasting ways to address micronutrient malnutrition (Obayelu & Osho, 2020). Cakes made from water yam and peanut skin may provide both people with a sufficient amount of nourishment. As a result, the study looked at the nutritional composition, functional properties, and sensory evaluation of cake made from a mixture of water yam, peanut skin, and wheat flour.

MATERIALS AND METHODS

A retail store in the Kumasi central market was where the water yam tubers and roasted peanuts were bought. The same supplier also provided other baking essentials like eggs, sugar, baking powder, fat, milk, and vanilla essence. Analytical-grade supplies, reagents, and chemicals were employed throughout.

Preparation of flour samples

Production of water yam flour: Olu (2012) describes how water yam flour was made using a common method for making quick yam flour. To guarantee effective heat circulation during blanching and drying, the water yam tuber was hand peeled with a sharp stainless steel knife and sliced into thin slices. To prevent the yam slices from browning, they were rinsed. Slices of yam were quickly blanched at 100°C for 5 minutes after being drained. The pre-cooked yam slices were dried at 60°C for 24 hours. The dried yam slices were ground and sealed in a plastic bag.

Preparation of peanut skin powder (PS): The roasted kernels were mechanically peeled after 20 minutes of roasting at 165 oC. The skins of the peanuts were mechanically separated, finely ground in a grinder, then sieved through a mesh size of 60 (0.25 mm). When not in use, the dried peanut skin (PS) powder was maintained in sealed polyethylene bags and kept at a temperature of -18 Oc (Yu et al., 2005).

Preparation of flour blends

Wheat, water yam and peanut skin flour were formulated in different ratios ranging from 90:6:4, 80:15:5, 70:20:10 and 60:25:15 respectively. One hundred percent (100%) wheat flour served as control sample, the samples were represented with the codes AA, AB, AC, AD, and AE respectively. At speed 5 for 4 minutes, a Kenwood mixer was used to mix flour samples in a consistent manner.

Preparation of Cake

For the cake's preparation, Ceserani and Kinton's (2008) method was used with slight adjustment. In a stainless steel bowl, the margarine and sugar were hand creamed for 10 minutes until fluffy. After beating the egg for three minutes, vanilla extract was added. It was progressively incorporated into the whipped mixture while the beating continued. Samples of several composite flour mixes were separately sieved, along with salt and baking powder, and the mixture was then gradually folded in with a metal spoon. When the batter reached a soft consistency, browning was added and thoroughly combined. The batter was poured into a six-inch prepared baking pan and baked for 40 minutes at 200°C and another 20 minutes at 170°C in a preheated oven. To check if the cake was baked, a skewer was placed in the centre of it. The cakes were cooked, and then allowed to cool for three minutes in the pan before being turned out onto wire racks for additional cooling and analysis.

Table 1: Formulation of ingredients for cake preparation

INGREDIENTS	AA	AB	AC	AD	AE
Soft wheat flour (g)	100	90	80	70	60
Water yam flour (g)	0	6	15	20	25
Peanut skin flour (g)	0	4	5	10	15
sugar (g)	60	60	60	60	60
Margarine (g)	100	100	100	100	100
Eggs (large size) (g)	250	250	250	250	250
Baking powder (g)	5	5	5	5	5
Milk powder (g)	10	10	10	10	10
Salt (g)	1	1	1	1	1
Browning (ml)	10	10	10	10	10
Vanilla essence (ml)	5	5	5	5	5

Keys: AA(100% wheat flour, AB(90% wheat flour, 6% yam flour and 4% peanut skin flour), AC(80% wheat flour, 15% yam flour and 5% peanut skin flour), AD(70% wheat flour, 20% yam flour and 10% peanut skin flour), AE(60% wheat flour, 25% yam flour and 15% peanut skin flour),

Proximate composition

Proximate Analysis

The determination of moisture, ash, protein, fat, crude fibre and carbohydrate were done using AOAC (2000) methods.

Determination of moisture

The AOAC (1990) method was used to calculate the moisture content of the sample. 2 g of the samples were measured out onto Petri dishes, put in the oven uncovered for 3 hours at 130-150°C, and then cooked. After being taken out of the oven, the samples were placed in a desiccator to cool for 15 minutes before being weighed. Up until the mass didn't change, the procedure was repeated. The equation was used to convert the weight loss to a percentage of moisture content loss:

$$\text{Moisture content} = \frac{\text{weight loss} \times 100\%}{\text{Weight of sample}}$$

Determination of crude protein

An adaptation of the AOAC [1990] method was used to determine the samples' crude protein content. 0.8 g of each sample were digested using the Kjeldahl digestion method in a fume chamber. The digestion was allowed to cool before being distilled into boric acid containing bromocresor green indicators. The digestion was first diluted with water, followed by solutions of sodium thiosulphate and sodium hydroxide. The samples were then titrated using 0.1N hydrochloric acid (HCl) solutions. After carrying out identical blank titrations, the equation was used to estimate the percentage protein content:

Crude protein = Nitrogen × 6.25 (1 mL of 0.1N HCl = 0.0014gN)

Determination of ash

The ash content of the sample was ascertained using the AOAC [1990] technique. A sample of about 5 g was weighed into previously weighted ash dishes, then it was heated for five hours at 550 10°C in a muffle furnace. After cooling, it was weighed to a constant mass. The resulting ash (percentage) was calculated as follows:

$$\text{Ash content} = \frac{W2-W3}{W2-W1} X100$$

Where W1 is the weight of empty crucible; W2 is the weight of crucible + weight of sample before ashing; and W3 is the weight of crucible + weight of sample after ashing

Determination of crude fat

Using a modified version of the AOAC [1990] technique, the crude fat content of the samples was ascertained. Soxhlet thimbles were used to weigh 2 g of the prepared material, which was then put into an extraction flask of a predetermined weight. It took 5 hours to extract the diethyl ether. The diethyl ether was ultimately removed via evaporation in an electrical bath. The flask's remaining fat was dried in the oven at 60°C for 30 minutes, and then, after cooling for 15 minutes, it was weighed. Here is how the fat content (%age) was calculated:

$$\text{Fat content} = \frac{\text{Weight of fat} \times 100\%}{\text{Weight of sample}}$$

Determination of crude fiber

A modified version of the AOAC (1990) method was used to determine the samples' crude fibre content. The material was weighed at 1 g, and 100 mL of trichloroacetic acid was utilised as the digesting agent. The solution was brought to a boil and then maintained at 50–60 °C for about 40 minutes. The solution was filtered using Whitman filter paper after the flask was removed from the heater and given some time to cool. Methylated spirits and hot water were used to remove the residue. The filtrate was put in the muffle furnace and heated to 550°C for 30 minutes before being cooled and weighed. The proportion of crude fibre content was calculated using the following formula: Crude fiber = the loss in weight after incineration × 100

Determination of carbohydrate

The percentage of carbohydrates in the samples was calculated using the equation and the AOAC (2005) technique: Carbohydrate = 100 – (% Moisture + % Fat + + % Protein + % Crude fiber + % Ash)

Functional Properties

Water and oil absorption capacity

Using the approach outlined by Chandra et al., (2015), the water/oil absorption capacity and emulsion stability of the different flours were assessed. One gramme (1g) of the flour sample was mixed with 10 millilitres of oil, and the suspension was vortexed for five minutes. The acquired suspension was centrifuged at 3500 rpm for 30 minutes, after which it was decanted and the supernatant measured in a graduated cylinder with a capacity of 10 ml. Using the formula, the oil's density and calculated oil absorption capacity were determined;

$$\text{Oil absorption capacity (\% OAC)} = \frac{(y-z)\times d}{x} \times 100$$

Where y= initial volume of oil added

Z = volume of supernatant collected

X = initial weight of (dried) sample taken

D = density of oil

y-z = volume of water retained by the sample after centrifugation

Water absorption capacity

One gramme (1g) of the sample was dissolved in 10 millilitres of distilled water, and the solution was vortexed for five minutes. Centrifuging was done on the 3500 rpm suspension after it had been purchased. Afterwards, it was decanted and measured with supernatant in a graduated cylinder with a 10ml capacity. With the assumed water density of 1.0 gcm-3, the water absorption capacity is calculated as

$$\text{Water absorption capacity (\% WAC)} = \frac{y-z}{x} \times 100$$

Where y = initial volume of water added

Z = volume of supernatant collected

X = initial weight of (dried) sample taken

y-z = volume of water retained by the sample after centrifugation

Bulk density

The bulk density (BD) of the flour samples were calculated using the method presented by Amandikwa et al. (2015). 100g of the sample were weighed straight into a graduated cylinder with a capacity of 250ml, and the measuring cylinder was tapped 10 to 15 times until there was no change in volume.

$$\text{Bulk density} = \frac{\text{weight of sample (g)}}{\text{Volume of sample after tapping (ml)}}$$

Sensory evaluation

For the evaluation, fifty (50) panellists who had had training in descriptive analysis for cakes were selected. The cakes were all presented to the panellists in natural light and at room temperature. Participants received portions of cake coded AA, AB, AC, AD, and AE for evaluation on white disposable plates. A 9-point hedonic scale was used to evaluate the samples' taste, aroma, colour, texture and general acceptability; 1 stood for "extreme dislike" and 9 for "intense like." The samples were examined with mouthwash in separate booths. The participants filled out the score forms after the tasting.

Statistical Analysis

In this work, experimental analyses were carried out in duplicate. The SPSS version 20.0 software was used for all data analysis. Least Significant Difference (LSD) (P<0.05) values were used to separate the means after an analysis of variance (ANOVA) was used to obtain the treatment means.

RESULTS AND DISCUSSION

Proximate composition of wheat, water yam and peanut skin composite flour cake

The proximate composition of the various cake samples is presented in Table 2. The data obtained shows that the moisture content of the various cake samples ranged from 11.79% to 17.50%. A cake sample made with 100% wheat flour had the highest value for moisture (17.50%), followed by 80%, 6%, 4% wheat-water yam-peanut skin blended flour cakes, while the least moisture content was recorded by sample AE with 25% and 15% water yam and peanut skin flour incorporation. The moisture content of the various cake samples was significantly different (P<0.05). The amount of moisture in food has a significant impact on its quality, ability to be preserved, and resistance to deterioration (Oko & Famurewa, 2014). In the current study, cakes with a high moisture content will be more vulnerable to microorganism attack, which will cause them to decay more quickly. Cakes with low moisture content are better suited for long-term storage if kept in a low relative humidity environment. Additionally, because of their increased dry matter content, they are more effective for industrial processing (Polycarp, Afoakwa, Budu, & Otoo, 2012). Meanwhile, the 100% wheat flour cake's high moisture level could affect the way it feels to the touch (Baah, et al., 2009). Because of its long shelf life and nutritious value, incorporating 15% peanut skin with 25% water yam blended flour could be advantageous when baking cakes (Awuchi, 2019).

The samples of cakes had an ash percentage that ranged from 1.12 to 1.50%. Cake sample AA made with 100% wheat flour had the highest ash content measurement, whereas sample AE had the lowest measurement (60% wheat flour, 25% yam flour, and 15% peanut skin flour). The high value of ash content observed for sample AA is a sign that the ash content of wheat flour is higher. As the percentage of water yam and peanut peel increased, it was seen that the cakes' ash content reduced. The gradual decline in ash level seen in cakes made from mixtures of water yam and peanut skin could be attributed to the low ash content of the water yam and peanut skin used in this investigation. The resulting cake samples had significantly different ash contents ($p < 0.05$). Although lower than the values (1.35 to 2.10%) reported by China et al. (2020) for the ash content of cookies made from wheat/cooking banana flour blends, the ash content values (1.12-1.50%) recorded for cake samples in this study. A food product's ash content provides a general indication of the mineral composition of that food product (Iwe et al., 2016).

The samples of cakes had a crude fibre level that ranged from 0.60 to 1.23%. Cakes made using samples AC (80% wheat flour, 15% yam flour, and 5% peanut skin flour) and AD (70% wheat flour, 20% yam flour, and 10% peanut skin flour) had the highest levels of crude fibre, whereas cakes made with sample AB (90% wheat flour, 6% yam flour, and 4% peanut skin flour) had the lowest levels. There were significant differences among them all ($p<0.05$). As the percentage of water yam and peanut skin flour rose, the results showed an increase in fibre content. This may be due to the fact that water yams and peanut skin contain a larger quantity of fibre than wheat. Fibre is a crucial component of a balanced diet and is necessary for several bodily functions, including digestion and the cardiovascular system. It is advised to consume the appropriate amounts of dietary fibre from a variety of plant foods because it is good for your health, helps with digestion, prevents diabetes, some cancers, and cardiovascular disease, as well as helping to lose weight (Dahl & Stewart, 2015). It is possible to suggest water yam and peanut skin as two examples of the many plant foods that can help people satisfy their daily fibre needs. Low crude fibre content (0.60%) was found in cakes made with 6% and 4% water yam and peanut skin, respectively. Diets deficient in fibre are undesirable, according to Awuchi (2019), as they have been linked to conditions like pile, appendicitis, and cancer that affect the colon.

The range of samples' fat contents was 12.52 to 19.70%. Cake made from 100% wheat flour (the control) had the maximum fat content, whereas the sample's composition was 60% wheat, 25% yam, and 15% peanut skin. The outcome showed that when the amount of both peanut skin and white water yam flour increased, the fat content significantly decreased. It might be because peanut skin and water yam are poor sources of fat. A high fat content boosts the product's energy value while simultaneously making it more susceptible to rancidity (Fasasi, 2009). A cake with less fat will be less likely to go rancid, especially if it is stored in an environment that will prevent it. Consequently, cakes with the low-fat content found in this study can be suggested as low-fat foods that are beneficial for weight loss and lowering cholesterol. The inclusion of peanut skin in the water yam recipe is what causes the goods to generally contain less fat. With higher levels of substitution, it was found that the fat content was reduced ($p<0.05$)

The protein values of the cake samples ranged from 8.24%- 8.58% with a composite cake sample AE (60% wheat flour, 25% yam flour and 15% peanut skin flour) having the highest protein content, while the 100% wheat flour cake recorded the least protein content. It was observed that increasing the quantity of the water yam and peanut skin flour resulted in a corresponding increase in the composite cake samples. This suggests that the protein level of the cake samples was influenced by both the water yam and the skin of the peanut. Due to wheat's reduced protein content, which is comparable to that of water yam and peanut skin, the cake made from sample AA had a low protein value. The composite flour used in this study contained wheat, which has been reported to contain significant amounts of protein (Kumar et al., 2011). The results revealed a significant difference ($p<0.05$) between the composite cake and the 100% cake samples. According to Ma et al. (2014), peanut skin contains 9.2 g of protein per 100 g. Similarly, Nepote et al. (2002) discovered that peanut skins have significant protein content (12.32 g/100 g).

The carbohydrate content of the cake samples ranged from 50.60%- 52.86% respectively. Cake sample AC made with 15% yam flour and 5% peanut skin flour has the highest carbohydrate content (52.86%) while the carbohydrate value of 100% cake is 50.73%. Cake made with 6% and 4% of water yam and peanut skin blends had the least carbohydrate content (50.60%). The results revealed that increasing the amounts of water yam and peanut skin reduced the carbohydrate content in the cake. There was a significant difference ($p<0.05$) between all the cake samples. The body uses carbohydrates as its primary energy source to power the kidneys, heart, muscles, brain, heart, and central nervous system. A diet low in carbohydrates may result in ketosis (Awuchi et al., 2020). Water yams and peanut skin contain a comparatively large amount of carbohydrates, which makes them a stable alternative food source for meeting carbohydrate needs. The result contradicts the findings by Obasi and Ifediba (2018) and Bolarinwa et al., (2019) that baked goods made with wheat flour substitutes have less carbohydrate.

Table 2: Proximate composition of wheat, water yam and peanut skin composite flour cake

Samples	**Moisture** (%)	**Ash** (%)	**Fibre** (%)	**Fat** (%)	**Protein** (%)	**CHO** (%)
AA	17.50^{a}	1.50^{a}	1.20^{c}	19.70^{a}	8.24^{e}	50.73^{c}
AB	15.90^{b}	1.34^{b}	1.22^{e}	17.74^{b}	8.30^{d}	50.80^{e}
AC	14.73^{c}	1.30^{c}	1.23^{a}	15.00^{c}	8.38^{c}	52.86^{a}
AD	13.26^{d}	1.21^{d}	1.25^{b}	14.30^{d}	8.47^{b}	51.84^{b}
AE	11.79^{e}	1.12^{e}	1.28^{d}	12.52^{e}	8.58^{a}	52.71^{d}

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different ($p>0.05$). Keys: AA(100% wheat flour, AB(90% wheat flour, 6% yam flour and 4% peanut skin flour), AC(80% wheat flour, 15% yam flour and 5% peanut skin flour), AD(70% wheat flour, 20% yam flour and 10% peanut skin flour), AE(60% wheat flour, 25% yam flour and 15% peanut skin flour),

Functional Properties

Table 2 displays the results of the functional characteristics of flour blends made from water yam, peanut skin and wheat. The capacity to absorb water ranged from 100.25 to 170 g/ml. Flour sample AE with 60% wheat flour, 25% yam flour and 15% peanut skin flour had the lowest water absorption capacity (WAC), while sample AA, which contained 100% flour, recorded the highest WAC. The ability of flour to absorb water is a crucial characteristic of food. Its power to absorb water is determined by the protein in flour's capacity to physically bind water (Ikpeme et al., 2010). According to reports, flours with high water absorption rates make suitable components for bakery applications since they enhance handling qualities and increase the freshness of baked goods (Abiodun et al., 2003). Additionally, the ability of a substance to absorb water is crucial for bulking and consistency. Abiodun et al., (2003) found that composite flour made from water yam and soybean had a water absorption capacity value range of 1.26 - 1.64 g/ml. Regarding the ability to absorb water, his findings differ from those of the current study. In comparison to Olapade's research, this study's maximal water absorption capacity measurement was higher. According to Fekria et al. (2012), the ability of the flour to absorb and retain water and oil may aid in improving the binding capacity and flavour retention of extended meat products, as well as mouthfeel and reducing moisture and fat losses.

The oil absorption capacity (OAC) ranged from 153.160.24 of which flour sample AA (153) recorded the lowest OAC followed by sample AB (154.52) and the highest was sample AE (162.24). It was observed that increasing the water yam and peanut skin flour blends resulted in a corresponding increase in the OAC. The results revealed a significant difference ($P<0.05$) between the composite flour blends and the control. An indicator of a food's potential to absorb oil is its oil absorption capacity (OAC). In the OAC of AA and AB, AC, AD, and AE, a significant difference ($p< 0.05$) was seen. These results were greater than the ones that Ohizua et al. (2017) and Adegunwa et al. (2017) had previously published (111.06% and 129.73%), respectively. According to Oluwalana et al. (2011), the presence of protein may have increased the exposure of non-polar amino acids to fat and increased their hydrophobicity, which causes samples AD and AE to absorb more oil, contributing to the high value of OAC found in this study. However, the decreased ability of the flour to entrap fat at the polar end of its protein chain, which may be attributable to a drop in its protein content, may be the cause of the decreased OAC in the composite flour samples (Abeshu et al., 2016). Sample AA, which has the greatest OAC, may be beneficial in the baking sector as a flavour retention agent. When employed in food preparation, the OAC helps to increase the flavour and texture (Adegunwa et al., 2017).

Bulk density reveals the proportional volume of packaging material needed. Bulk density ranged from 0.66-0.70%. The findings of the current study indicated that 100% wheat flour has a higher bulk density than water yam and peanut composites and should be employed in applications where these qualities are needed. However, there was no discernible change in bulk density ($p>0.05$) between any of the flours. In general, a higher bulk density is preferred for easier dispersion and a thinner paste (Udensi and Eke, 2000). Since the products could be conveniently transported and disseminated to the necessary locations, low bulk densities of flour are favourable physical characteristics when determining transportation and storability (Agunbiade and Sanni, 2001).

The swelling capacity of the flour blends ranged from 1.38-1.60%. Flour sample AA (100% wheat flour) recorded the highest swelling capacity, while sample AE (60% wheat flour, 25% yam flour, and 15% peanut skin flour) had the least swelling capacity. The results revealed that increasing the water yam and peanut skin flour blends resulted in a corresponding decrease in the swelling capacity. There was a significant difference (P<0.05) between the 100% wheat flour and the composite flour. Protein and starch levels are frequently correlated with swelling capacity (Woolfe, 1992). In flour with higher protein content, the starch granules may become buried in a rigid protein matrix, which hinders the starch's ability to absorb water and swell (Aprianita et al., 2009). Granule swelling is mostly caused by amylopectin. As a result, wheat flour's greater ability to swell shows that it contains more amylopectin than water yam and peanut flour (Tester & Morrison, 1990).

Table 3: Functional Properties of wheat-water yam –peanut skin blended flour

Samples	WAC	OAC	BD	SWC
AA	170.00^{a}	153.00^{a}	0.70^{a}	1.60^{a}
AB	154.40^{b}	154.52^{b}	0.69^{a}	1.55^{b}
AC	137.65^{c}	156.15^{c}	0.68^{a}	1.48^{c}
AD	120.68^{d}	157.70^{d}	0.67^{a}	1.43^{d}
AE	100.25^{e}	160.24^{e}	0.66^{a}	1.38^{e}

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different (p>0.05).WAC = Water Absorption Capacity, OAC = Oil Absorption Capacity, BD = Bulk Density, SWC = Swelling Capacity.

Sensory attributes of wheat-water yam-peanut skin flour cake samples

Table 4 displays the mean sensory evaluation scores for various coded cake samples (AA, AB, AC, AD, and AE). The results of taste, flavour, colour, texture and overall acceptance of the various cake samples showed a significant (p<0.05) impact on all of the evaluated metrics. Cake sample AC with 15% and 5% water yam and peanut skin flour incorporation had the highest score for taste while sample AE (25% yam flour and 15% peanut skin flour*)* was the least in terms of taste score. It was observed that increasing the percentages of water yam and peanut skin caused a corresponding decrease in taste in samples AD and AE. This finding is in line with Igbabul et al. (2018), who prepared cookies using moringa leaf powder and wheat flour and found that the taste of the cookies increased noticeably from the standard sample's 4.40 to the moringa leaf powder-fortified sample's 7.60. This varied taste could be a result of the varied proportions of water yam and peanut skin flour used. The flavour of any baking good has also an important role towards its perception. The result showed that addition of water yam and peanut skin flour improved flavour initially as there was an increase in score up to 8.41 for 15% and 5% addition of water yam and peanut skin flour. But later, the addition of water yam and peanut skin flour above 15% and 15% decreased the sensory score of colour, texture and over all acceptance. The colour ranged from 7.95 to 8.40 with the 100% wheat cake (AA) having the highest colour score (8.40) and least was for sample AE *(*60% wheat flour, 25% yam flour and 15% peanut skin flour*)* with 7.95. The findings differed from Igbabul et al. (2018) who noted a comparable improvement in the texture of cookies made using wheat composite flour, sweet detar, and moringa leaf powder. They were of the view that crispiness of baked goods might enhance its desired textural quality.

The cake sample AC with 15% and 5% water yam and peanut skin flour was significantly different ($P<0.05$) from the 100% wheat cake (sample AA). Sample AC had the highest overall acceptance ratings (8.39) while sample AA (8.30) was third best ratings in terms of overall acceptance. It was observed that increasing the amounts of water yam and peanut skin resulted in a corresponding decrease in overall acceptability of the cake. With a general acceptability score of 8.0, Igbabul et al. (2018) reported an increase in the general acceptance of moringa leaf powder-fortified cookies from 4.66 to 8.13. The panellists gave high marks to cake sample that contained 15% and 5% water yam and peanut skin flour. Sensory investigation of enhanced cake is significant because this could change consumers' attitudes towards cake with the best nutritional benefits. In our investigation, all baked products were well received, with the addition of 15% and 5% water yam and peanut skin cake receiving the best sensory evaluation. It can be assumed that the interaction between texture and flavour influences most snacks' organoleptic selection more than colour.

Table 4: Sensory attributes of wheat-water yam-peanut skin flour cake samples

Samples	Taste	Flavour	Colour	Texture	Overall Acceptance
AA	7.26^{c}	7.20^{d}	8.40^{a}	8.30^{a}	8.30^{c}
AB	7.28^{b}	7.38^{b}	8.30^{b}	9.28^{b}	8.32^{c}
AC	8.10^{a}	8.41^{a}	8.28^{c}	8.27^{c}	8.39^{a}
AD	7.20^{d}	7.32^{c}	8.20^{d}	8.23^{d}	7.45^{b}
AE	7.15^{e}	7.10^{e}	7.95^{e}	7.50^{e}	7.40^{e}

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different (p>0.05). Keys: AA(100% wheat flour, AB(90% wheat flour, 6% yam flour and 4% peanut skin flour), AC(80% wheat flour, 15% yam flour and 5% peanut skin flour), AD(70% wheat flour, 20% yam flour and 10% peanut skin flour), AE(60% wheat flour, 25% yam flour and 15% peanut skin flour)

CONCLUSION

The study was conducted to evaluate the effect of partial substitution of wheat, water yam, and peanut skin flour in cake making. The research results showed that water yam and peanut skin contain more protein than wheat flour, which is consistent with the allowed quantity of protein in water yam and peanut blended flour for cakes. The incorporation of water yam and peanut skin in cake making increased the fibre, protein, and carbohydrate content while reducing the moisture, ash, and fat contents. The functional properties of the flours revealed a decrease in water absorption capacity, oil absorption capacity, bulk density, and swelling capacity as the percentage of composite flours increased. Sensory evaluation of the various cake samples showed an overall acceptance for all the parameters assessed, hence, water yam and peanut skin flour may be used industrially to make other products like pastries and other flour products to increase their use while reducing post-harvest losses and resulting in higher crop yields. Though all the cake samples were accepted, incorporating 15% water yam and 5% peanut skin flour resulted in high acceptance by the panellists.

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