

Nutrient Composition and Physical Characteristics of Biscuits Produced from Composite Blends of wheat, Coconut and Defatted Fluted Pumpkin Seed Flour

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Research Article

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Abstract

The objective of this work was to evaluate the functional properties of flour blends from wheat, coconut and defatted fluted pumpkin seed, produce biscuits from these flour blends and evaluate the nutrient composition and physical characteristics of the composite biscuits. Wheat/coconut/defatted fluted pumpkin seed flours were blended in the ratio; 100/0/0, 80/10/10, 70/20/10, 60/30/10, 50/40/10, 40/50/10 and labelled as sample A, B, C, D, E and F respectively. Biscuits were baked with these composite flours using the creaming method. Swelling power, water absorption and oil absorption capacity of the composite flour ranged from 5.00 – 9.38, 0.14 – 2.50 and 0.39 – 1.58 ml/g respectively, with sample A flour given significantly higher swelling power of 9.38 ml/g followed by sample B flour (5.58 ml/g). Moisture content of samples A, E and F were not significantly different. The ash content of sample E was significantly higher (1.67%), followed by sample D (1.58%). Fat and crude fibre content of the biscuits increased significantly with increased inclusion of coconut flour. Sample B gave significantly higher protein content of 12.27% while sample A recorded higher carbohydrate content of 72.27%. Energy value increased with increased addition of coconut flour from 444.69 – 485.37kcal/100g. There was no significant difference in the Spread ratio of samples A, B and C. Break strength was shown to reduce significantly as the substitution ratio of coconut flour increased. Production of wheat-based composite biscuits with 10 to 40 % coconut and 10% defatted fluted pumpkin seed flour is highly recommended.

Keywords: Biscuits, Nutrient, Functional, Physical, Coconut, Fluted Pumpkin

Introduction

Biscuit and other baked food products are important items belonging to the class of food that are sold as ready-to-serve [1]. They have become post weaning food as mothers feed their children with it at day cares, schools, offices, churches and other institutions. Biscuit is a rich source of protein, fat, carbohydrate, mineral and energy [2]. Wheat because of its unique rheological properties is the most preferred cereal for biscuits and other baked products [3]. The superiority of wheat over other cereals is due to the presence of gluten which inherently imparts all the essential qualities to their products [4]. Most baked products made purely from wheat and other cereals are poor sources of protein and other essential nutrients [5]. Oil seeds and protein-rich legumes are used in composite with wheat and other cereals to enhance their nutritional properties [6]. Composite biscuit is becoming increasingly popular because of its nutritional advantages [7].

Coconut and defatted fluted pumpkin seed flour (DFPSF)

can act as good source of nutrient supplement in baked products. Coconut flour is a rich source of dietary fiber [8]. In recent times, there has been an increasing demand towards consumption of high fiber biscuits due to their health promoting and functional properties. Diets rich in fibre have been proven to have positive effect on health as their consumption has been related to decreased incidence of several diseases [9]. Coconut flour is free of trans-fatty acids and is low in digestible carbohydrate [8]. Coconut flour is a unique product that is rich and healthy source of nutrient. It can be used as bulking agents, filling agents and as a substitute for cereal and roots flour at certain levels. Trinidad et al. reported earlier that the glycaemic index of coconut flour supplemented foods decreased with increasing levels of dietary fiber from coconut flour. Coconut flour is free from gluten and phytic acid and is loaded with numerous nutrients [10]. The health benefits of coconut flour include protection against strokes, significant reduction in blood pressure, enhanced energy production and it also boosts thyroid function, balances blood sugar and insulin level, and cleanses the body's internal systems [11].

Fluted pumpkin (*Tefairiaoccidentalis*) seeds are rich in fat and protein, and can therefore be used in nutrient fortification, to enhance a well-balanced diet [12]. Giambi et al. reported that fluted pumpkin seed contained 27% protein and 54% fat [13]. Fluted pumpkin seed flour have been used for nutritional enrichment and for maintaining the rheological and sensory properties of confectionery products [14]. Pumpkin seed flour, unlike wheat, is rich in fibre (47.9%, dry mass) and thus, enhances intestinal functions and produce the feeling of satiety that is essential in body weight control [15]. It has potential for use as a functional agent in many formulated foods [16]. Thus, use of Fluted pumpkin seed flour as wheat flour substitute in biscuit production has great potential to bridge the nutritional gap as might be presented in wheat. This could help to reduce protein-energy malnutrition in school children and adults, been that the major determinants of malnutrition in Africa are low availability of nutritious foods and inadequate consumption of protein rich diets [17]. A lot of work has been done using many types of cereals and pulses to make composite flour for different types of bakery products but there is paucity of information on the use of defatted fluted pumpkin seed flour even though the crop is abundantly grown in Nigeria and it is cheaper than wheat. The objective of this study therefore was to determine the Nutrient composition and physical characteristics of biscuits produced from different inclusion levels of coconut and DFPSF in wheat flour using conventional biscuit production recipe and to access the functional properties of the composite flour.

Materials and Methods

Mature coconuts and fluted pumpkin fruits were purchased from Port Harcourt Fruit market, Rivers State, Nigeria. Wheat

flour, sugar, salt, margarine and yeast used for this study were purchased from confectionery store, Rivers State, Nigeria and transported in air tight high density polyethylene bag. The chemicals used were of analytical grade manufactured by British Drug House, London and purchased from a chemical store in Port Harcourt.

Defatting of Fluted Pumpkin Seed Flour

Fluted pumpkin seed was dehulled, cleaned and oven dried at 60°C for 24h in a hot air oven (model QUB 305010G, Gallenkamp, UK), milled using a laboratory mill (model MXAC2105, Panasonic, Japan) [18]. The flour was defatted using the method described by Rosenthal et al., with slight modification [19]. The milled seed flour was made into paste by adding warm and cold water intermittently. The paste was placed in boiling water and allowed to boil for 6 hours. Oil floating to the surface and kept to stand overnight in the refrigerator. To allow for oil crystallization making it easier to be skimmed off the mixture. Defatted pumpkin flour was dried in a hot air oven to 12 – 13% moisture content, sieved to fine particles.

Preparation of Coconut Flour

Coconut endosperm after the removal of shell and paring, was shredded, grated and oven dried at 60°C for 24h in a hot air oven (model QUB 305010G, Gallenkamp, UK), milled using a laboratory mill (model MXAC2105, Panasonic, Japan) to obtain coconut flour [18].

Composite Flour and Biscuit production

Six blends were prepared by mixing wheat, coconut and defatted fluted pumpkin seed flours in the following proportions: 100: 0: 0, 80: 10: 10, 70: 20: 10, 60: 30: 10, 50: 40: 10 and 40:50: 10% as shown in Table 1.

Samples	Ingredient								
	WF (g)	CNF (g)	DFPSF(g)	Sugar (g)	Fat (g)	Milk (g)	Salt (g)	H ₂ O (g)	Baking powder(g)
A	100	0	0	40	30	4	2	15	1
B	80	10	10	40	30	4	2	15	1
C	70	20	10	40	30	4	2	15	1
D	60	30	10	40	30	4	2	15	1
E	50	40	10	40	30	4	2	15	1
F	40	50	10	40	30	4	2	15	1

Table 1: Production Blends for Wheat/Coconut/Fluted Pumpkin Seed Flour Biscuits.

Key: A = 100% WF (control)
 B = 80% WF + 10% CNF+10% DFPSF
 C = 70% WF + 20% CNF+10% DFPSF
 D = 60% WF + 30% CNF+10% DFPSF
 E = 50% WF + 40% CNF+10% DFPSF
 F = 40% WF + 50% CNF+10% DFPSF
 WF= wheat flour
 DFPSF= defatted fluted pumpkin seed flour

Composite biscuit was produced using the creaming method described by Okaka [1]. The basic ingredient used were; composite flour (100g), fat (30g), sucrose (40g), milk (4g), salt (2g) and baking powder (1g). The sugar and fat were initially creamed in a mixer to produce a creamy mixture before the flour and other dry ingredients were added. Thereafter, the mixture was thoroughly mixed with little water to form hard consistent dough. The dough was kneaded cut and baked at 160°C for 20min, cooled and packed as shown in Figure 1.

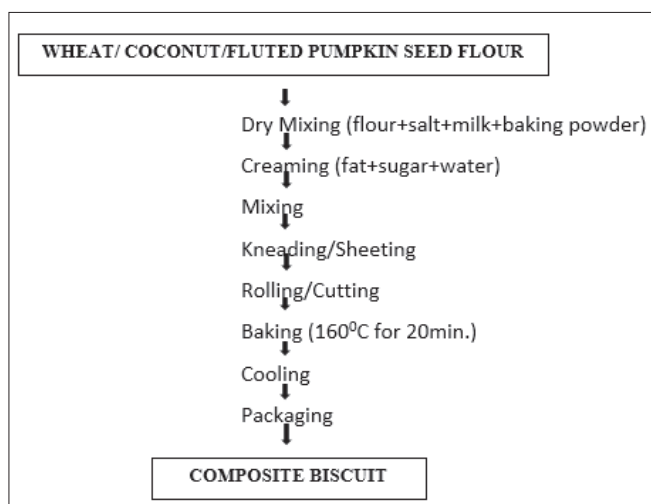


Figure 1: Flow Diagram for Production of Biscuit from Composite Flour

Functional Properties of Composite Flour

Water and Oil Absorption Capacities

Oil and water absorption capacity were determined according to the method described by Sathe and Salunkhe [20]. One gram of the sample was added to 3ml of water/corn oil in a 15ml conical graduated centrifuge tube. The emulsion was mixed with a vortex mixer for 2 min, incubated at room temperature for 30 min and later centrifuge at 4896 x g for 25 min. After centrifuging, the clear supernatant was decanted and the volume of separated oil was noted. Water/Oil absorption capacity (WAC and OAC) of 1g of sample was evaluated by difference using the formula:

$$\text{WAC and OAC(\%)} = \frac{V_2 - V_1}{100 \times 1.0}$$

(Where V_2 and V_1 are the initial and final volumes respectively). Analysis was performed in duplicate.

Swelling Power

The swelling power was carried out using the method of Takashi and Sieb [21]. One gram of the flour sample was weighed and transferred into a 100ml conical flask. 15ml of distilled water was added to the sample and mixed. The sample suspension was sent to a shaker bath (Gallenkamp, UK) set at 1000C for 1 hour. The conical flask and its content were cooled under running water, transferred into weighed centrifuge tube. This was centrifuged at 3000rpm for 30 minutes using a digital control centrifuge (L – 600, China). The weight of the centrifuge tube and swollen sediment was also taken to calculate for swelling power.

$$\text{Swelling power (cm}^3\text{/g)} = \frac{\text{weight of swollen sediment} \times 100}{\text{weight of sample}}$$

Bulk Density

A previously marked 10ml measuring cylinder was filled with 2g of flour sample. The measuring cylinder base was gently tapped on the laboratory table severally to a constant volume. The values were recorded and bulk density (g/ml) was calculated by the method of Akpapunam and Markakis [22], using the following formula:

$$\text{Bulk density} = \frac{\text{Weight of samples}}{\text{Volume of sample after tapping (g/cm}^3\text{)}}$$

Proximate Composition of Biscuits

The moisture, crude protein (N x 6.25), crude fibre, crude fat and total ash contents of biscuit samples were analysed using the method described by Association of Official Analytical Chemists' [23]. Total carbohydrate content of the samples was calculated by difference (subtracting the sum of percent moisture, crude protein, crude fibre, crude fat, and ash from 100%).

Energy value (kcal per 100 g) was estimated using the Atwater conversion factor [24]. Energy (kcal per 100 g) = [9 × Lipids% + 4 × Proteins% + 4 × Carbohydrates%]

Physical Properties of Composite Biscuits

Spread ratio

The spread ratio was calculated as diameter of biscuits divided by height [25]. Two rows of five well-formed biscuits were made and the height was measured. They were also arranged horizontally edge to edge and the sum of the diameters was also measured.

Break strength

Okaka and Isieh method was used [26]. Biscuit of known thickness was placed centrally between two parallel metal bars (3 cm apart). The weights were added on the biscuit until the biscuit snapped. The least weight that caused the breaking of the biscuit was regarded as the break strength of the biscuit.

Thickness and Weight

Thickness of the biscuit sample was determined using a venire calliper, while the weight of the sample was determined with a top loading balance [4].

Statistical Analysis

All the analyses were carried out in duplicate. Data obtained were subjected to Analysis of Variance (ANOVA); differences between means were evaluated using Turkey's multiple comparison tests with 95% confidence level. The statistical package in Minitab software version 16 was used.

Results

Functional Properties of Composite Flour

Result for the functional properties of wheat, coconut and fluted pumpkin seed composite flour is shown in Table 2. Swelling power, water absorption and oil absorption capacity ranged from 5.00 – 9.38, 0.14 – 2.50 and 0.39 – 1.58 ml/g respectively, with sample A given significantly ($P < 0.05$) higher swelling power of 9.38 ml/g followed by sample B (5.58 ml/g). The least swelling power of 5.00 ml/g was seen in sample F. Bulk density ranged from 0.59 – 0.87 g/cm³, with sample B given significantly ($P < 0.05$) higher value followed by sample C (0.81g/cm³) and sample D (0.75g/cm³). Swelling power and bulk density decreased with increase in substitution of coconut flour, while water and oil absorption increased with increased substitution of coconut flour.

Samples	Swelling P.(cm ³ /g)	Water Abs (ml/g)	Oil Abs.(ml/g)	Bulk Density (g/cm ³)
A	9.38 ^a ±0.230	0.14 ^f ±0.022	0.39 ^f ±0.000	0.66 ^d ±0.000
B	5.58 ^b ± 0.004	2.45 ^b ±0.001	1.27 ^e ±0.008	0.87 ^a ±0.006
C	5.29 ^c ±0.103	2.31 ^d ±0.007	1.40 ^d ±0.008	0.81 ^b ±0.000
D	5.20 ^{cd} ±0.077	2.12 ^e ±0.004	1.45 ^e ±0.006	0.75 ^c ±0.004
E	5.15 ^d ±0.100	2.35 ^e ±0.005	1.55 ^b ±0.009	0.66 ^d ±0.001
F	5.00 ^e ±0.000	2.50 ^a ±0.012	1.58 ^a ±0.001	0.59 ^e ±0.001

Table 2: Functional Properties of Wheat/Coconut/Fluted Pumpkin Seed Flour Blends

Values are mean ± standard deviation of triplicate samples. Mean values bearing different superscript in the same column differ significantly (P<0.05).

Key: A = 100% WF (control), B = 80% WF + 10% CNF+10% DFPSF, C = 70% WF + 20% CNF+10% DFPSF, D = 60% WF + 30% CNF+10% DFPSF, E = 50% WF + 40% CNF+10% DFPSF, F = 40% WF + 50% CNF+10% DFPSF, WF= wheat flour, DFPSF= defatted fluted pumpkin seed flour, CNF= coconut flour

Proximate Composition

As shown in Table 3, the moisture, Ash and fat content ranged from 3.66 – 4.11, 1.16 – 1.67 and 13.33 – 22.38 % respectively. Moisture content of samples A, E and F were not significantly different (P>0.05). The ash content of sample E was significantly (P<0.05) higher, followed by sample D (1.58%). Ash contents of samples C and F were not significantly different (P>0.05). Fat content of sample F was significantly higher followed by sample E (22.29%), fat and crude fibre content increased significantly with increased inclusion of coconut flour. The crude fibre content of sample F was significantly higher followed by sample E (1.17%). The protein and total carbohydrate contents ranged from 8.93 – 12.27 and 61.53 – 72.25% respectively, with sample B given significantly (P<0.05) higher protein content of 12.27% and sample A recording higher carbohydrate content of 72.27%.

Samples	Moisture (%)	Ash (%)	Fat (%)	Crude Fiber (%)	protein (%)	Carbohydrate (%)
A	3.68 ^b ±0.008	1.16 ^e ±0.002	13.33 ^c ±0.191	0.65 ^e ±0.007	8.93 ^e ±0.031	72.25 ^a ±0.006
B	4.11 ^a ±0.001	1.32 ^d ±0.026	20.13 ^d ± 0.000	0.64 ^e ±0.009	12.27 ^a ±0.005	61.53 ^e ±0.073
C	3.54 ^d ±0.002	1.52 ^c ±0.019	20.14 ^d ±0.004	0.68 ^d ±0.001	11.61 ^b ±0.001	62.51 ^b ±0.014
D	3.66 ^c ±0.001	1.58 ^b ±0.005	21.69 ^c ±0.010	1.09 ^c ±0.050	10.32 ^c ±0.006	61.66 ^d ±0.002
E	3.68 ^b ±0.008	1.67 ^a ±0.006	22.29 ^b ±0.004	1.17 ^b ±0.036	9.58 ^d ± 0.013	61.61 ^{de} ±0.005
F	3.68 ^b ±0.003	1.52 ^c ±0.003	22.38 ^a ±0.012	1.27 ^a ±0.011	8.94 ^e ±0.023	62.21 ^e ±0.000

Table 3: Proximate Composition of Wheat/Coconut/Fluted Pumpkin Seed Flour Biscuit

Values are means ± standard deviation of triplicate samples.

Mean values bearing different superscripts in the same column differ significantly (P<0.05)

Key: A = 100% WF (control), B = 80% WF + 10% CNF+10% DFPSF, C = 70% WF + 20% CNF+10% DFPSF, D = 60% WF + 30% CNF+10% DFPSF, E = 50% WF + 40% CNF+10% DFPSF, F = 40% WF + 50% CNF+10% DFPSF, WF= wheat flour, DFPSF= defatted fluted pumpkin seed flour, CNF= coconut flour

Energy Value

From Figure 2, the energy values were respectively 444.69, 476.37, 477.74, 483.13, 485.37 and 486.02 kcal/100g. The energy values of the composite biscuits were shown to increase significantly (P<0.05) with increased in level of coconut flour addition.

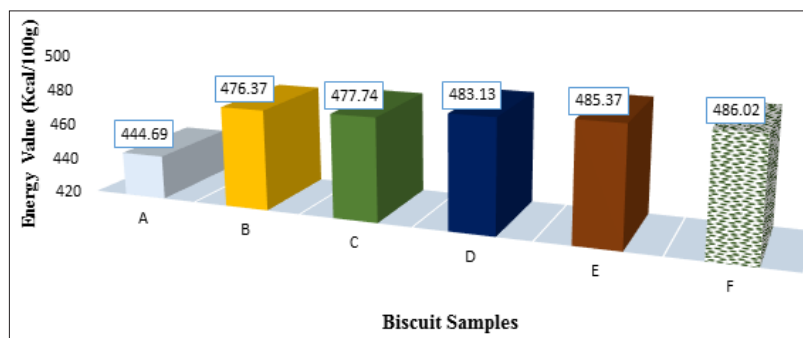


Figure 2: Energy Value of Biscuits Produced from Wheat, Coconut and Defatted Fluted Pumpkin Seed Flour Blends

Key: A = 100% WF (control), B = 80% WF + 10% CNF+10% DFPSF, C = 70% WF + 20% CNF+10% DFPSF, D = 60% WF + 30% CNF+10% DFPSF, E = 50% WF + 40% CNF+10% DFPSF, F = 40% WF + 50% CNF+10% DFPSF, WF= wheat flour, DFPSF= defatted fluted pumpkin seed flour, CNF= coconut flour

Physical Properties

The weight and thickness of the biscuit samples ranged from

Samples	Weight (g)	Thickness (cm)	Spread Ratio	Break Strength (g)
A	8.25 ^b ±0.008	0.40 ^a ±0.002	7.26 ^c ±0.002	700 ^a ±0.027
B	8.30 ^a ±0.001	0.40 ^a ±0.006	7.25 ^c ± 0.010	680 ^b ±0.011
C	8.15 ^c ±0.002	0.37 ^b ±0.000	7.25 ^c ±0.003	630 ^c ±1.101
D	7.85 ^d ±0.001	0.37 ^b ±0.000	7.30 ^b ±0.000	610 ^d ±0.450
E	7.75 ^e ±0.005	0.33 ^c ±0.008	7.30 ^b ±0.002	595 ^e ±1.036
F	6.89 ^f ±0.008	0.33 ^c ±0.001	7.32 ^a ±0.002	545 ^f ±0.255

Table 4 : Physical Properties of Biscuits Produced from Wheat, Coconut and Defatted Fluted Pumpkin Seed Flour Blends

Values are means ± standard deviation of triplicate samples.

Mean values bearing different superscripts in the same column differ significantly (P<0.05)

Key: A = 100% WF (control), B = 80% WF + 10% CNF+10% DFPSF, C = 70% WF + 20% CNF+10% DFPSF, D = 60% WF + 30% CNF+10% DFPSF, E = 50% WF + 40% CNF+10% DFPSF, F = 40% WF + 50% CNF+10% DFPSF, WF= wheat flour, DFPSF= defatted fluted pumpkin seed flour, CNF= coconut flour

Discussion

Functional Properties of Composite Flour

Functional properties are those parameters that determine the application and end use of food material for various food products [27]. Ajatta et al. defined functional properties of food as the characteristics of food ingredients different from nutritional quality which has a great influence on its utilization [28]. Wijaya and Mehta stated that functional properties evaluate the roles and functions of specific component in foods or how ingredients behave during preparation and cooking [29]. How they affect the finish food products in terms of colour, taste and texture [30]. It is also characterized by the structure, quality, nutritional value and acceptability of a food product. These characteristics are vital to evaluate and possibly help to predict how proteins, fat, fibre and carbohydrates may behave in specific structures [31]. As shown in the result, swelling power of sample A (100% wheat flour) was significantly (P<0.05) higher. High swelling power of the control (Sample A) is probably due to its content of gluten protein. Swelling capacity ranging from 10.01 – 13.27ml/g had earlier been reported for coconut flour [32]. Adegunwa et al. reported that swollen power of flour granules is an indication of the extent of associative forces inside the granule [33]. The swollen power of flour depends on size of particles, types, and variety and preparation methods. The variation in the swollen power of flour is a sign of the extent of associated forces within the granule, this indicates the degree of exposure of the internal structure of the starch present in the flour due to surplus of moisture [34].

Water absorption and oil absorption values increased significantly with increased substitution of wheat flour with coconut and defatted fluted pumpkin seed flour. Increase in

6.89 – 8.30g and 0.33 – 0.40cm respectively (Table 4). Sample B gave significantly (P<0.05) higher weight followed by sample A. However, there was no significant (P>0.05) difference in their thickness. Spread ratio and break strength values ranged from 7.25 – 7.32 and 545 – 700g respectively. There was no significant difference in the Spread ratio of samples A, B and C. Break strength was shown to reduce significantly as the substitution ratio of coconut flour increased.

water and oil absorption capacity is probably due to increased protein content of the composite flour. The capability of food materials to absorb water to a large extent is associated to its protein content [35,36]. WAC describes flour-water association ability under limited water supply. High WAC is also attributed to loose structure of starch polymers while low value indicates the compactness of the structure [37,38,39]. It also refers to the ability of protein matrix, such as protein particles, protein gels to absorb and retain water against gravity. This water includes bound, hydrodynamic water, capillary water, and physically entrapped water. The physically entrapped water is however the largest fraction, it imparts juiciness and tenderness to various foods. Water absorption capacity is a desirable trait in foods such as custards, sausages and dough because these are supposed to imbibe water without dissolution of protein, thereby attaining body thickening and viscosity [40]. The increase in oil absorption capacity of the composite flour samples may be due to entrapment of oil related to the non-polar side chains of proteins [41].

The bulk density of sample B and C were significantly (P<0.05) higher, this was probably due to substitution of wheat with defatted fluted pumpkin seed flour. Bulk density reduced subsequently due to increase addition of coconut flour. Bulk density is a measure of heaviness of a flour sample, and is generally affected by particle size. It is also important for determining packaging requirement, material handling and application in wet processing in the food industry [42].

Proximate Composition of Composite Biscuits

From the result of proximate composition of biscuits produced from composites flour of wheat, coconut and defatted fluted pumpkin seed, Moisture content of sample D was significantly lower. Low moisture content is an indication of better storage

potential [28]. Higher moisture content of sample B was probably due to increase in protein content as a result of defatted fluted pumpkin seed flour, protein has more affinity to moisture than carbohydrate. Moisture content of the biscuits were higher than 1.84 – 2.55% reported earlier for wheat and beniseed flour composite biscuits [25]. Variation in moisture content of biscuits is probably due to variation in ingredients, oven temperature and time. The increase in ash content of composite biscuits could be attributed to the higher level of ash content in coconut and fluted pumpkin seed flour. Similar research report indicated that total mineral content of biscuits obtained from 40% of lima bean, 35% sorghum and 25% of wheat composite flour was higher than that of 100% wheat biscuits [43]. Ash content is an indication of the mineral content of the product [44].

Increase in fat content of the composite biscuits was due to increased content of coconut flour.

The fat composition of biscuit formulated from millet and cowpea was reported to increase as the level of cowpea complementation increased [45]. High fat content of 39.10% was earlier reported for cake produced from 30% coconut flour in composite with wheat flour [46]. Fats serve a variety of functions, including all three purposes of nutrition: to form and maintain body structures, to regulate metabolism, and to provide the second main source of energy [11]. Crude fibre content of the composite biscuits increased with increased inclusion of coconut flour, which is rich in dietary fiber [10]. Consumption of dietary fiber has numerous benefits in protection against heart disease and cancer, normalization of blood lipids, regulation of glucose absorption and insulin secretion and prevention of constipation and diverticulitis disease [47]. Protein content of samples B and C were significantly higher due to inclusion of defatted fluted pumpkin seed flour, however, protein content of sample F was not significantly different from that of the control (sample A), as protein content was seen to reduce with increased substitution of coconut flour. Total carbohydrate content of sample a (100% wheat flour biscuit) was significantly higher. Cereals are major source of carbohydrates [48].

Energy Value of Composite Biscuits

The energy value of the biscuit samples increased with increase addition of coconut flour. This was probably due to high fat content of coconut flour [49]. Fat provide the second main source of energy, it is the most energy-dense macronutrient [11,50]. Energy value was estimated from the contributions of protein, fat and carbohydrate, taking into account the digestibility of each and their heat of combustion [13].

Physical Properties

As shown in the results, decrease in weight of the composite biscuits is probably due to lighter weight of the dried coconut flour. Similar reduction was also observed by Agu and Okoli for wheat, beniseed and unripe plantain composite biscuits [25]. Higher thickness of samples A and B was probably due to higher wheat content and increased swelling power owing

to the presence of gluten in wheat flour. The spread ratio of the biscuit increased from 7.25 to 7.32. The increase is an indication of the binding properties of the flour and of the texture of the biscuits. This increase may be as a result of increase in coconut flour as both coconut and defatted fluted pumpkin seed flour has poor binding properties. Increased spread ratio might also be due to difference in particle size between the wheat and the composite flour [4]. The break strength reduced significantly with increased ratio of coconut flour. This may be due to poor binding quality of coconut and defatted fluted pumpkin seed flour to form a strong network in a molten state at baking temperature [25, 51-54].

Conclusion

From the results, swelling power and bulk density of the composite flour decreased with increase in substitution of coconut flour, while water and oil absorption increased with increased substitution of coconut flour. Increase in water and oil absorption capacity is probably due to increased protein content of the composite flour. The fat, protein, crude fibre and energy value and spread ratio of the biscuits increased considerably with increased percentage of coconut and defatted fluted pumpkin seed flour. The break strength however reduced significantly with increased ratio of coconut flour. This study showed that production of biscuits with composite flour of coconut, fluted pumpkin seed and wheat give products with enhanced nutrient and physical qualities.

Production of wheat-based composite biscuits with 10 to 40 % coconut and 10% defatted fluted pumpkin seed flour is highly recommended.

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