WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 11, Issue 16, 9-25. Research Article ISSN 2277– 7105

EVALUATION OF NUTRIENT, PHYTOCHEMICAL AND ORGANOLEPTIC PROPERTIES OF COOKIES MADE FROM WHEAT, COCOYAM, CASHEW AND GROUNDNUT PASTE BLENDS

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Article Received on
21 Sept. 2022,
Revised on 11 October 2022,
Accepted on 01 Nov. 2022
DOI: 10.20959/wjpr202216-26123

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ABSTRACT

Across the world, people of all ages enjoy and commonly eat cookies as snacks. In this study, cookies made from blends of wheat flour, cocoyam flour, cashew nut, and groundnut paste were evaluated for nutrient, phytochemical, and organoleptic properties. Wholesome wheat, Cocoyam corm, cashew nut, groundnut and other baking ingredients were purchased from Relief Market in Owerri, Imo State. The wheat flour, cocoyam flour, cashew and groundnut paste were prepared separately and blended in different proportions. Three blends (Sample A, 100% wheat flour; Sample B, 25:50:25 of groundnut, wheat flour and cocoyam; Sample C, 50:25:25 wheat flour, cashew nut and cocoyam) were produced. Proximate composition, mineral and phytochemical content of the cookies were determined using standard procedures. The result shows that the moisture content of the blends ranged from 7.30 to 8.54%, carbohydrate content ranged from 61.37 to 63.92%, protein content ranged from 8.14 to 10.38%, fat content ranged from 14.19 to 18.28%, crude fiber ranged from 1.50 to 2.07%, ash content ranged from 2.41 to 2.85%. The carbohydrate content of the samples varied significantly ($p<0.05$). The calcium content ranged from 42.63 to 52.77 mg/100g, iron content ranged from 0.96 to 1.27 mg/100g and zinc from 1.4 - 1.84 mg/100g. There was significant difference in the alkaloid, flavonoid and saponin contents of the samples with sample A being significantly higher ($P<0.05$) in alkaloid and flavonoid while sample C, 50:25:25 wheat flour,

cocoyam flour and cashew nut were higher in saponin 0.70 mg/100g. Result of the sensory evaluation shows that sample A (control) was the best preferred. The test cookie samples with cocoyam flour, cashew nut and groundnut paste substitutions generally had higher protein, ash, energy, fat, fiber and calcium contents than the wheat flour cookies. The test cookies were also higher in flavonoid and saponin. The control (wheat flour cookies) was rated higher than the rest of the cookies in taste, texture, colour and overall acceptability, although their scores indicates that they were also acceptable. Production of cookies with wheat flour, cocoyam, cashew nut and groundnut blends has a good nutritional potential and should be encouraged as wheat flour substitute.

KEYWORDS: Cookies, nutrient, organoleptic properties, Standard procedure.

1.0 INTRODUCTION

Cookies are popular and commonly consumed snacks by individuals of all ages across the globe (Okpala, Okoli, & Udensi, 2013[1]). Rapid industrialization, urbanization and population growth have increased the consumption of processed food and bakery products, resulting in high production costs and an increase in demand for wheat imports (Igbabul, Iorliam & Umana, 2015[2]; Dotsey, 2009[3]). Wheat, the cereal of choice for making bakery product especially cookies, is not grown in tropical regions such as Nigeria because of the unfavourable climatic factors. As a result, regions with limited supplies of wheat flour must rely on imports of wheat flour or exclude wheat and its products from the food menu (Holt, Resurreccion, & Mc-Watters, 1992[4]) to save cost. The consumption of cereal-based foods like cookies at affordable cost requires the development of an adequate substitute for wheat (Eneche, 1999[5]). The substitute should be readily available, inexpensive, and functionally equivalent to wheat flour. Flours made from a combination of cereals, legumes, or tubers will have a higher nutritional value than those made from only cereals, legumes, or tubers, giving them the advantage of improved overall nutrition (Igbabul, Iorliam & Umana, 2015[2]; FAO, 1995[6]).

More so, Inadequate intake and limited variety of food sources of protein in developing countries has resulted to different forms of malnutrition in both children and adults. In Nigeria, Protein malnutrition has been reported to be a major health problem particularly among children under the age of five (United Nations Children Emergency Fund [UNICEF], 1996[7]; Ozoka, 2018[8]). The need to find low-cost, high-quality protein sources cannot be exaggerated since the reliance on plant proteins by humans are extremely high. Because these

plant proteins are known to contain limiting amino acids (Ihekoronye & Ngoddy, 1985[9]), it is important to combine them with cereals or other protein source in proportions that will increase the protein intake of such consumers, thus the emergence of composite flour and its products (Okpala & Okoli, 2011[10]).

Composite flour is a blend of non-wheat flours (flour from roots and tubers, legumes, or cereals) designed to meet specific functional and nutritional needs (Dendy, 1992[11]). Typically, the goal of formulating composite flour is to produce a product that is superior to the individual components in terms of improved properties, performances and saves cost. When choosing constituents for composite flour blends, materials should be readily available, culturally acceptable, and provide enhanced nutritional potency (Akobundu, Ubbaonu, & Ndupuh, 1998[12]). Due to their ready-to-eat form, widespread consumption, relatively long shelf life, and healthful dietary quality, cookies have been suggested as a better use of composite flour than other pastry product (McWatters et al., 2003[13]). The use of composite flours derived from cereals, legumes, and tubers for cookie production is therefore expected to enhance the utilization of local crops as raw materials and improve the nutritive quality of cookies. On this backdrop thereof, this study evaluated the nutrient, phytochemical and organoleptic properties of cookies made from blends of wheat, cocoyam, cashew nuts flour and groundnut paste. The food crops investigated in this work are commonly produce in Nigeria but underutilized. Cocoyam flour has been used in baking products because it has fine granule-starch, which enhances binding and lessens breakage of snack products (Huang, 2005[14]).

2.0 MATERIALS AND METHODS

Experimental study design was used to determine the nutrient, phytochemical and organoleptic properties of cookies made from blends of wheat, cocoyam, cashew nuts flour and groundnut paste in different proportion.

2.1 Procurement of Experimental materials

Wholesome wheat, cocoyam, groundnut, cashew nut and other baking ingredients such as sugar, butter, baking powder and canola oil were purchased from Relief market Owerri, Imo State, Nigeria. The market is located along Mbaise road, Owerri, Imo state.

2.2 Preparation of Raw Material

2.2.1 Preparation of wheat flour

The Wheat flour was produced using the modified method of Joel, Fatima and Stephen[15] (2014). The material was sorted, washed with clean water to remove dust particles, and then sun dried in a dust free area. The washed raw material was roasted by heating at a temperature of about 157°C for 15 minutes and stirred throughout the cooking time so as to achieve even cooking. After roasting, the sample was grinded using a hammer mill. The powdered (ground) material sieved so as to remove particles with larger size and the resulting flour stored in air-tight glass containers at room temperature (20-25^{0}C) until further use.

2.2.2 Preparation of Cocoyam flour

The fresh corms of cocoyam were washed, peeled, washed again and shredded into thin slices according to the method by Kabuo et al.[16] (2018). The slices were sundried for 2h, after which the slices were spread on trays and placed in the oven. It was then dried at a temperature of 65^{0}C for 9h to make the sample crispy. The dried samples were removed from the oven, cooled and ground into flour using a disc attrition mill. The flour was sieved using a 60-mesh sieve. The cocoyam flour was stored in air tight bottles, labelled and kept in a cool dry place for further analysis.

2.2.3 Preparation of groundnut flour

Groundnut flour was prepared using the modified method described by Yusufu, Opega and Aka[17] (2016). Raw groundnut was sorted by removing the unwanted particles such as stones, shell, spoilt ones and debris, and then soaked for 5 minutes in sparingly hot water (70^{0}C). The water was drained out. The dried seed samples were air dried for 10 minutes, toasted in an oven at 160^{0}C for 45 minutes, allowed to cool by rubbing them together with palms. It was dehulled, winnowed and milled/grind to obtain groundnut paste using an electric blender and packaged.

2.2.4 Preparation of cashew nut flour

The roasted cashew nut purchased from the Everyday supermarket inside the Relief market was sorted and milled using an electrical blender until it becomes a fine paste. The cashew paste was allowed to cool and then packaged in an airtight container.

2.3 Sample formulation

The flour of wheat, cocoyam, groundnut and cashew nut were mixed in different ratios following the method by Ikuomola, Otutu and Oluniran[18] (2017) as follows;

Sample	Wheat (%)	Cocoyam (%)	Groundnut (%)	Cashew nut (%)
Sample A	100	-	-	-
Sample B	50	25	25	-
Sample C	50	25	-	25

2.4 Recipe for Cookies Production

The method according to Okpala[19] (2011) was adopted with little modification

Ingredients	Quantity
Flour	250g
Shortening (Napa margarine)	70g
Sugar	52.5g
Egg	1 whole egg
Milk	3.5 tsp
Nutmeg	¼ tsp
Vanilla flavor	6.2 mls
Baking powder	½ tsp
Salt	½ tsp

Production procedure of the cookies

The shortening and the sugar were creamed using Reomono hand mixer (model No RMD-6829) until it was fluffy. Egg and vanilla flavor were added while mixing continues for about 10 minutes. Appropriate amount of flour, baking powder, milk, nutmeg and salt were slowly introduced into the mixture and mixed properly to form dough. The dough was wrapped in a cling film and placed in the fridge for 30 minutes, then rolled again and cut into circular shapes with cookies cutter and placed on well-greased baking trays. Baking was carried out at 160̊ C for 20 minutes (Okpala, Ekwe & Sampson, 2013[20]). The cookies were removed, cooled and packaged for further analysis.

2.5 Chemical Analysis of the samples

2.5.1 Proximate analysis

The proximate composition of the sample was determined using the standard methods of analysis of Association of Official Analytical Chemists (AOAC, 2010[21]).

2.5.2 Mineral determination

Zinc and Iron were determined following the standard method of AOAC[21] (2010). Calcium was determined using the method described by Pearson[22] (1976).

2.5.3 Phytochemical analysis

Flavonoids was determined using the Boham and Kocipai-Abyazan[23] (1994) method. Alkaloid and Saponin content were determined by the alkaline precipitation-gravimetric method described by Harborne[24] (1973).

2.5.4 Sensory Evaluation

The sensory qualities were evaluated by twenty (20) panelists drawn from the Department of Nutrition and Dietetic, Imo State University, Owerri, Nigeria. The characteristics such as color, flavor, taste, texture, and general acceptability of the cookie samples were rated and scored using a 9-point hedonic scale, in which 9 denotes extremely liked, 8 denotes liked very much, 7 denotes liked moderately, 6 denotes liked much, 5 denotes neither like nor dislike, 4 denotes dislike, 3 denotes dislike moderately, 2 denotes dislike very much, and 1 denotes disliked extremely (Ihekoronye & Ngoddy, 1985[9]). The samples were served in clean plates at the same time. Tap water was made available for mouth rinsing between samples. The panelists were asked to freely comment on samples from questionnaires given to them. Cookies produced from 100% wheat flour served as controls.

2.5.5 Statistical analysis

The data gotten from chemical analysis was computed and statistically analyzed with the Statistical package for service solution (SPSS) version 23. Means and standard deviation were used to analyze the data. The mean was compared using one-way analysis of variance (ANOVA). To separate the means, the Duncan multiple range test was used. The significance level was accepted at $P < 0.05$.

3.0 RESULTS

3.1 Proximate compositions of the samples

Table 3.1 below shows the proximate composition of the cookie samples. The result revealed that the moisture content of the sample A, B and C were 8.54%, 7.30% and 7.72% respectively. The crude protein content of the samples ranged from 8.14% to 10.38%, with sample C (10.38%) having the highest crude protein content, followed by sample A (9.43%) and sample B (8.14%) respectively. Other proximate parameters were Fat content (14.19%, 18.28% and 15.14%), Crude fibre (1.50%, 2.07% and 1.96%), ash (2.43%, 2.85% and 2.41%) and carbohydrate (63.92, 61.37% and 62.41%) for Sample A, B and C respectively. Sample B

recorded the highest energy value (450.80), while the lowest was seen in Sample A (427.07). It was observed that there was significant difference in the proximate values obtained.

Table 3.1: Proximate compositions of the sample.

Nutrients	A	B	C
Moisture content (%)	$8.54^{a} \pm 0.05$	$7.30^{c} \pm 0.03$	$7.72^{b} \pm 0.05$
Crude protein (%)	$9.43^{b} \pm 0.01$	$8.14^{c} \pm 0.02$	$10.38^{a} \pm 0.02$
Fat (%)	$14.19^{c} \pm 0.02$	$18.28^{a} \pm 0.01$	$15.14^{b} \pm 0.03$
Crude fiber (%)	$1.50^{c} \pm 0.03$	$2.07^{a} \pm 0.04$	$1.96^{b} \pm 0.03$
Ash (%)	$2.43^{b} \pm 0.03$	$2.85^{a} \pm 0.03$	$2.41^{c} \pm 0.02$
Carbohydrate (%)	$63.92^{a} \pm 0.01$	$61.37^{c} \pm 0.07$	$62.41^{b} \pm 0.04$
Energy (Kcal)	$427.07^{c} \pm 0.42$	$450.80^{a} \pm 0.07$	$435.80^{b} \pm 0.42$

Means with different superscript within the row, differs significantly at ($P < 0.05$). Sample A = 100% wheat flour; Sample B = 50% wheat flour, 25% cocoyam flour and 25% groundnut flour; Sample C = 50% wheat flour, 25% cocoyam flour and 25% cashew nut paste.

3.2 Mineral compositions of the sample

Table 3.2 below shows the mineral composition of the cookie samples. There was significant difference ($P < 0.05$) in the mineral composition of the samples. Sample B recorded the highest calcium content (52.77 mg/100g), while the least calcium value (42.63 mg/100g) was seen in Sample A. The iron content of the samples ranged from 0.96 mg/100g to 1.27 mg/100g with sample A having the highest content and sample C having the least iron value. The zinc values of the samples indicate that the samples contained 1.84 mg/100g, 1.64 mg/100g and 1.47 mg/100g for sample A, B and C respectively.

Table 3.2: Mineral compositions of the samples.

Minerals (mg/100g)	A	B	C
Calcium	$42.63^{c} \pm 0.04$	$52.77^{a} \pm 0.02$	$43.56^{b} \pm 0.06$
Iron	$1.27^{a} \pm 0.01$	$1.08^{b} \pm 0.02$	$0.96^{c} \pm 0.02$
Zinc	$1.84^{a} \pm 0.02$	$1.64^{b} \pm 0.01$	$1.47^{c} \pm 0.03$

Means with different superscript within the row, differs significantly at ($P < 0.05$). Sample A = 100% wheat flour; Sample B = 50% wheat flour, 25% cocoyam flour and 25% groundnut flour; Sample C = 50% wheat flour, 25% cocoyam flour and 25% cashew nut paste.

3.3 Phytochemical compositions of the samples

Table 3.3 below shows the phytochemical content of the samples. There was significant difference ($P<0.05$) in the phytochemical composition of the samples. Sample B recorded the highest alkaloid content (0.27 mg/100g), while sample A has the least (0.04 mg/100g). The

flavonoid content of the samples ranged from 7.18 mg/100g in Sample A to 6.92 mg/100g in Sample B. Saponin content of sample C was 0.70 mg/100g, while sample A had 0.56 mg/100g.

Table 3.3: Phytochemical compositions of the samples.

Phytochemical (mg/100g)	A	B	C
Alkaloid (mg/100g)	$0.04^{c} \pm 0.02$	$0.27^{a} \pm 0.04$	$0.25^{b} \pm 0.03$
Flavonoid (mg/100g)	$7.18^{a} \pm 0.03$	$6.92^{c} \pm 0.02$	$6.98^{b} \pm 0.03$
Saponin (mg/100g)	$0.56^{c} \pm 0.02$	$0.66^{b} \pm 0.04$	$0.70^{a} \pm 0.01$

Means with different superscript within the row, differs significantly at ($P < 0.05$). Sample A = 100% wheat flour; Sample B = 50% wheat flour, 25% cocoyam flour and 25% groundnut flour; Sample C = 50% wheat flour, 25% cocoyam flour and 25% cashew nut paste.

3.4 Sensory properties of the samples

The table below shows the sensory properties of the samples. There was significant difference ($p<0.05$) in the sensory scores of the samples. Sample A recorded the best score for colour (8.05), taste (7.60), texture (7.25) and general acceptability rating (7.15) while the least colour (6.75), taste (7.05) and general acceptability rating (6.10) were seen in Sample C even though, sample B recorded the least texture (6.80). The highest aroma was seen in sample B (7.00) while the least was seen in sample C (6.35).

Table 3.4: Sensory properties of the samples.

Sample	A	B	C
Colour	$8.05^{a} \pm 1.43$	$7.30^{b} \pm 1.56$	$6.75^{c} \pm 1.48$
Taste	$7.60^{a} \pm 1.70$	$7.45^{b} \pm 1.54$	$7.05^{c} \pm 1.85$
Texture	$7.25^{a} \pm 1.62$	$6.80^{c} \pm 1.47$	$6.95^{b} \pm 1.64$
Aroma	$6.90^{b} \pm 1.62$	$7.00^{a} \pm 1.20$	$6.35^{c} \pm 1.79$
General Acceptability	$7.15^{a} \pm 1.84$	$6.80^{b} \pm 2.40$	$6.10^{c} \pm 2.31$

Mean values with different superscripts in the same row are significantly different ($p < 0.05$).

4.0 DISCUSSION

4.1 Proximate composition of the samples

The moisture content of the cookie samples was low (<10%). Low moisture content reduces the chances of product spoilage by micro-organisms and consequently guarantee good storage stability (Ayo, Nkama, & Adeworie, 2017[25]). However, low moisture content of the cookies (<10%) is an indication of high dry matter content and possibly prolonged shelf-life. The moisture content of the cookies obtained from the present study is slightly lower than 8.69 – 9.41% reported by Okoye and Obi[26] (2017) on cookies produced from wheat –

cocoyam flour composites blends. Ojinnaka and Agubolum[27] (2013) in their work on nutritional and sensory properties of cashew nut-wheat based cookies reported a moisture content of (6.40 - 7.14%) which was lower than (7.30 - 8.54%) obtained from the present study. This could be due to the low moisture content of cashew nut. Moreso, Hasan, Hossain, Hossain and Roy[29] (2010) reported moisture content (4.25 – 8.20) of cookies produced from groundnut - wheat flour which was consistent with that obtained from the present study. Cookies should have low moisture for safe storage and inhibition of microbial growth that could affect their quality.

The crude protein content of the cookies increased on addition of groundnut and cashew nut paste. The increased protein content of the cookies with addition of groundnut and cashew nut paste substitution level could be associated with the presence of greater protein in the nuts paste than in wheat flour (Ikuomola, Otutu, & Oluniran[18] 2017). In addition, groundnut nut is a valuable food resource on account of its protein content. The protein content obtained from the present study was consistent with reports by Go et al.[30] (2015), Eke-Ejiofor[31] (2013) and Onwuka[32] (2005) who worked on cookies produced from wheat flour, cocoyam and date palm fruit pulp as sugar substitute. However, the protein content from this study was higher than (5.48 – 8.3%) reported by Hasan et al.[29] (2010) who worked on cookies produced from groundnut, cocoyam and wheat flour. The high protein content reported in this study might be due to the addition of groundnut and cashew nut paste which are rich in protein. The protein content reported by Ojinnaka, Adeyeye, Asaolu, and Aluko[33] (2016), Taiwo, Ayodele, and Olajide[34] (2015) and Okoye and Obi[28] (2017) on cookies produced from wheat – African breadfruit flour were higher than that obtained from the present study. This could be as a result of higher protein content in breadnut. This study has shown that groundnut fortification would help in fighting protein malnutrition.

The results obtained from the present study shows that the fat content of the cookies increased on addition of groundnut and cashew nut paste. Fat content reported by Onwuka[32] (2005), Hasan et al.[29] (2010) on cookies produced from wheat – jackfruit seed flour composite was consistent with the present study. Okoye and Obi[28] (2017) also reported fat contents which were significantly lower than those obtained from the present study but consistent with Sample C (50% wheat flour, 25% cocoyam flour and 25% cashew nut paste). However, Eke-Ejiofor[31] (2013) who worked on cookies made from African breadfruit – cocoyam and wheat flour composite blends and Go et al.[30] (2015) on cookies made from

wheat – cocoyam flour composite blends reported a fat content of (21.93 – 27.66% and 22.10%) which were significantly higher ($p<0.05$) than that obtained from the present study. This high value could be as a result of the recipe or the specie of cocoyam used in their study. Fat is essential for the metabolism of fat-soluble vitamins such as Vitamin A, D, E and K. It also forms the structure of the nerve fibres and aids the insulation of vital organs of the body against mechanical injury.

Crude fibre content of the cookies increased on addition of cocoyam flour, groundnut and cashew paste. The crude fibre content of the cookies obtained from the present study was significantly lower ($p<0.05$) than that reported by Okoye and Obi[28] (2017) but consistent with that reported by Eke-Ejiofor[31] (2013) on cookies made from African breadfruit – sweet potato and wheat flour composite blends and Onwuka[32] (2005) on cookies produced from wheat flour, cocoyam and date palm fruit pulp as sugar substitute. However, a lower crude fibre content was reported by Ajani et al.[35] (2012) on snacks produced from breadfruit and cocoyam flour. Fibre is an important component of food as it enhances digestion, aids bowel movement and increases fecal bulk. It also helps to prevent inflammatory bowel disease and colorectal cancer.

The ash content is a measure of the nutritionally important minerals present in a food material (Oluwamukomi, Oluwalana & Akinbowale, 2011[36]). The ash content of the cookies increased on further addition of groundnut paste. This shows that groundnut contains nutritionally essential minerals. The ash content obtained from the present study is in consistent with 2.40% reported by Go et al.[30] (2015) on cookies produced from wheat – breadnut flour composite blends, (2.02 – 2.45%) by Hasan et al.[29] (2010) on cookies made from wheat – jackfruit flour composite and (1.67 – 2.50%) by Eke-Ejiofor[31] (2013) on cookies made from African breadfruit – cocoyam and wheat flour composite blends. Ajani et al.[35] (2012) also reported (2.03 – 2.12%) ash content for cookies made from wheat – cocoyam flour composite which was slightly lower than that obtained from the present study. However, higher ash values (4.29 – 5.45%) were reported by Ojinnaka et al.[33] (2016) on cookies produced from wheat, cocoyam and pigeon pea flour. This could be as a result of pigeon pea which has more nutrients being used as composite flour.

The carbohydrate content of the cookies decreased on addition of cocoyam flour, cashew nut and groundnut paste. This is because of the low carbohydrate content of cashew nut and groundnut paste. The carbohydrate content obtained from the study is consistent with 62.60%

by Go et al.[30] (2015), Eke-Ejiofor[31] (2013), Taiwo, Ayodele and Olajide[34] (2015) and (60.64 – 63.85%) by Hassan and Okoli[37] (2012). Carbohydrate is the major energy source of the body stream; it is the only source of energy (glucose) for the red blood cells and the major source for the brain. Carbohydrate is needed in large quantity in the body, thus the classification as a macronutrient.

The energy content of the cookies increased on addition of cocoyam flour, groundnut and cashew nut paste and was highest in sample B (25% groundnut, 50% wheat flour and 25% cocoyam flour). The result obtained from the present study was lower than 465.32 – 503.20 kcal reported by Onwuka[32] (2005) on cookies made from whole wheat, cashew nut and date palm fruit pulp as sugar substitute. According to Kleinman and Daniel[38] (2009), the energy content of the cookies can meet 85% of the required energy intake of preschool children per day.

4.2 Mineral composition of the samples

The present study showed that cookies produced from blend of wheat flour, cocoyam flour, groundnut and cashew nut paste was rich in minerals needed in the development of strong immune system. The present study showed higher calcium, iron and zinc values than 28.06mg/g, 1.05mg/g and 1.80% respectively by Nzeagwu and Onuwudiwe (2016) but in consistent with 42.34mg/g, 1.27mg/g and 1.84m% respectively reported by Ayogu, Abraham and Nnam (2017). The calcium values of the food samples increased on addition of groundnut paste. This could be as a result of the high calcium content of groundnut paste. However, results obtained were significantly higher ($p<0.05$) than those reported by Nanyen, Dooshima, Julius and Benbella[41] (2016), Okoye and Obi[28] (2017) and Ojinnaka et al.[42] (2016). The iron content of the samples decreased on addition of cocoyam flour, cashew nut and groundnut paste. This proves that cashew and groundnut are not excellent source of iron. Results obtained were significantly higher ($p<0.05$) than those reported by Nanyen et al.[41] (2016) and Eke-Ejiofor[31] (2013). Iron is a component of haemoglobin which is responsible for the red colour of the blood. It also assists many enzyme systems especially as cytochrome in the electron transport chain. The zinc content of the control sample (100% wheat flour) obtained from the present study is consistent with previous study reported by Nanyen et al.[41] (2016) on cookies produced from wheat – acha and mung bean flour. However, on addition of groundnut and cashew nut paste, the zinc content of the formulated blends decreased and was lower than those reported by Nanyen et al.[41] (2016). Hence, cashew nut and groundnut

paste are not good sources of zinc. Zinc is involved in myriads of functions in the body such as gene regulation, immune system function and reproductive function.

4.3 Phytochemical composition of the sample

The alkaloid contents obtained from the present study was in tandem with that reported by Okoye and Obi[28] (2017). The alkaloid values of the samples studied increased on addition of groundnut and cashew nut paste. The flavonoid content of the samples decreased on addition of groundnut and cashew nut paste. This suggests low flavonoid content of groundnut and cashew nut paste. However, results obtained were significantly higher than those reported by Nanyen et al.[41] (2016), Okoye and Obi[28] (2017) and Ojinnaka et al.[42] (2016). The saponin content result obtained from this present study is in line with previous study reported by Nanyen et al.[41] (2016) on cookies produced from wheat – acha and mung bean flour.

4.4 Sensory properties of the sample

Colour is very important parameter in judging the property of baked cookies. It does not only reflect the suitable raw material used for the preparation but also provides information about the formulation and quality of the product (McWatters et al., 2016[43]). The colour of the cookies reduced on addition of cocoyam flour, cashew nut and groundnut paste. This could be as a result of colour change during processing of the cookies. Results obtained were significantly lower than that reported by Eke-Ejiofor[31] (2013), Ojinnaka et al.[42] (2016) and Go et al.[30] (2015). However, Hasan et al.[29] (2010) reported colour values which were in concord with the present study.

Taste or flavour is the main criterion that makes the product to be liked or disliked (McWatters et al., 2016[43]). The taste of the cookies reduced on addition of cocoyam flour, cashew nut and groundnut paste. Results obtained from this study were significantly lower than that reported by Go et al.[30] (2015), except for Sample A which has similar taste value with previous study. Okoye and Obi[28] (2017) also reported taste values for cookies made from wheat – breadfruit flour composites which were significantly higher ($p<0.05$) than the present study. This could be as a result of the recipe used in the previous study.

The texture of the cookies reduced on addition of cocoyam flour, cashew nut and groundnut paste. Results obtained were consistent with that reported by Okoye and Obi[28] (2017), Ojinnaka et al.[42] (2016) and Nanyen et al.[41] (2016). Crispiness is a useful characteristic of cookies (Ubbor & Akobundu, 2009[44]) that determine consumer acceptance level and also

serve as a critical factor in determining the shelf-life of cookies (Piazza & Masi, 1997[45]). In this study, the crispness of the cookies was very low compared to previous studies by Go et al.[30] (2015), Ojinnaka et al.[42] (2016) and Onwuka[32] (2005).

Another factor that determines acceptance of made cookies prior to being tasted is aroma (Ubbor & Akobundu, 2009[44]). The results obtained from the present study on the aroma of the samples was significantly lower ($p<0.05$) than that reported by Go et al.[30] (2015). Eke-Ejiofor[31] (2013), Taiwo et al.[34] (2015) and Onwuka[32] (2005) also reported aroma values of biscuits made from wheat – breadfruit flour composites which agreed with the present study. However, Ojinnaka et al.[42] (2016) reported aroma values which were slightly higher than that obtained from the present study.

The overall acceptability of the cookies refers to the holistic view of the product as affected by all sensory properties being considered. The control sample was overtly accepted than the formulated blends. The overall rating of the cookies was fairly consistent with study reported by Taiwo et al.[34] (2015). However, Ajani et al.[35] (2012) and Asogwa, Hammed and Ndubuaku[46] (2008) reported higher values than those obtained from the present study.

4.5 CONCLUSION

The nutrient composition and sensory properties of the cookies produced from blend of wheat flour, cocoyam flour, cashew nut and groundnut paste investigated in this study showed that cocoyam flour, cashew nut and groundnut paste can be used successfully as a partial substitute for wheat flour in the production of cookies. The test cookie samples with cocoyam flour, cashew nut and groundnut paste substitutions generally had higher protein, ash, energy, fat, fiber and calcium contents than the wheat flour cookies alone. The test cookies were also higher in flavonoid and saponin. The control (wheat flour cookies) was rated higher than the rest of the cookies in taste, texture, colour and overall acceptability, although their scores indicates that they were also acceptable.

4.6 Recommendation

The use of cocoyam flour, cashew nut and groundnut paste in cookies has a searing nutritional potential and should be encouraged as a wheat flour substitute to baking industries. 2. Further studies should be carried out on the anti-nutrients and storage capacity of the cookies to ensure safety and wholesomeness of the products on shelf.

REFERENCES

1. Okpala L, Okoli E, Udensi E. Physico-chemical and sensory properties of cookies made from blends of germinated pigeon pea, fermented sorghum, and cocoyam flours. Food science & nutrition, 2013; 1(1): 8–14. https://doi.org/10.1002/fsn3.2
2. Igbabul BD, Iorliam BM, Umana EN. Physicochemical and Sensory Properties of Cookies Produced from Composite Flours of Wheat, Cocoyam and African Yam Beans. Journal of Food Research, 2015; 4(2). doi:10.5539/jfr.v4n2p150.
3. Dotsey P. The use of cocoyam, cassava and wheat flour composite in the production of rock cakes. HND Dissertation, Cape Coast Polytechnic, Cape Coast, Ghana, 2009; 1: 7-40.
4. Holt SD, Resurreccion VA, Mc-Watters KH. Formulation, evaluation and optimization of tortillas containing wheat, cowpea and peanut flours using mixture response surface methodology. J Food Sci., 1992; 57(1): 121-127. http://dx.doi.org/10.1111/j.1365-2621.1992.tb05438.x
5. Eneche HE. Biscuit making potentials of millet/pigeon pea flour blends. Plant Foods Hum. Nutr, 1999; 54: 21-27. http://dx.doi.org/10.1023/a:1008031618117
6. FAO. Sorghum and Millet in Human Nutrition. Food and Agriculture Organization of the United Nations, Food and Nutrition series, No 27, Rome, 1995.
7. United Nations Children Emergency Fund. Child Nutrition. NewYork, USA; Published for UNICEF by Oxford Universities Press, 1996; 82.
8. Ozoka CN. Burden of malnutrition in children under 5 years in Nigeria: problem definition, ethical justification and recommendations. J Trop Dis., 2018; 6(268): 2.
9. Ihekoronye AI, Ngoddy PO. Integrated Food Science and Technology for the Tropics, London; Macmillan, 1985.
10. Okpala LC, Okoli EC. Nutritional evaluation of cookies produced from pigeonpea, cocoyam and sorghum flour blends. African Journal of Biotechnology, 2011; 10(3): 433-438. Available online at http://www.academicjournals.org/AJB
11. Dendy DAV. Composite flour-past, present, and future: A review with special emphasis on the place of composite flour in the semi-arid zones. Utilization of sorghum and millets, 1992; 502: 67.
12. Akobundu ENT, Ubbaonu CN, Ndupuh CE. Studies on the baking potential of non-wheat composite flours. J Food Sci Technol, 1998; 25: 211-214.

13. McWatters KH, Ouedraogo JB, Resurreccion AVA, Hung Y, Phillips RD. Physical and sensory characteristics of sugar cookies containing mixtures of wheat, fonio (Digitaria exilis) and cowpea (Vigna unguiculata) flours. Int J Food Sci Technol, 2003; 38: 403-410.
14. Huang D. Selecting an optimum starch for snack development (online). 2005; Available from:http://www.foodinnovation.com/pdf/Selecting%20Optimal%20Starch.pdf.
15. Joel N, Fatima K, Stephen F. Production and quality assessment of enriched cookies from whole wheat and full fat soya. European Journal of Food Science and Technology, 2014; 2(2): 19-29.
16. Kabuo NO, Alagbaoso OS, Omeire GC, Peter-Ikechukwu AI, Akajiaku LO, Obasi AC. Production and Evaluation of Biscuits from Cocoyam (Xanthosoma Sagittifolium Cv Okoriko)-Wheat Composite Flour. Research Journal of Food and Nutrition, 2018; 2(2): 53-61.
17. Yusufu PA, Opega JL, Aka OM. Effects of partial replacement of wheat with peanut flour on the chemical, sensory and microbial quality of bread. Nigerian journal of nutritional sciences, 2016; 37: 1.
18. Ikuomola DS, Otutu OL, Oluniran DD. Quality assessment of cookies produced from wheat flour and malted barley (Hordeum vulgare) bran blends. Cogent Food & Agriculture, 2017; 3(1): 1293471.
19. Okpala LC. Nutritional evaluation of cookies produced from sorghum flour blend. African journal of biotechnology, 2011; 127: 133.
20. Okpala W, Ekwe A, Sampson A. Future therapies for food allergies. J Allergy Clin Immunol, 2013; 103: 133.
21. Association of Official Analytical Chemist (AOAC). Official Methods of Analysis (18th edition), Washington DC, USA; AOAC, 2010.
22. Pearson D. The Chemical Analysis of Foods (7th ed). London; Churchil Living stone, 1976; 324.
23. Boham B, Kocipai-Abyazan R. Flavonoids and condensed tannins from leaves of Vaccinium vaticulatum and V.calycinium. Journal of Pacific Science, 1994; 48: 458-463.
24. Harborne J. Phytochemical methods: A guide to modern techniques of plant analysis. London; Chapman A & Hall, 1973.
25. Ayo JA, Ayo VA, Nkama I, Adeworie R. Physiochemical, invitro digestibility and organoleptic evaluation of acha-wheat biscuit supplemented with soybean flour. Nigerian Food Journal, 2017; 25: 15-17.

26. Okoye R, Obi P. The analysis of nutrients in foods. London; Academic Press, 2017; 166–182.
27. Ojinnaka MC, Agubolum FU. Nutritional and sensory properties of cashew nut-wheat based cookies. American Journal of food and Nutrition, 2013; 2157-0167.
28. Okoye J, Obi CD. Nutrient composition and sensory properties of wheat African breadfruit composite cookies. Sky Journal of Food Science, 2017; 6(3): 27-32.
29. Hasan SMK, Hossain MA, Hossain MJ, Roy J, Sarker MSH. Preparation of biscuit from jackfruit (Artocarpus heterophyllus) seed flour blended with wheat flour. The Agriculturists, 2010; 8(1): 10-18.
30. Go MB, Velos SP, Minyamin AV, Bagsit RD, Pableo RG. Sensory evaluation, shelflife and nutritional composition of breadnut (Artocarpus camansi) cookies. Tropical Technology Journal, 2015; 19(1): 1-7.
31. Eke-Ejiofor J. Proximate and sensory properties of African breadfruit and sweet potato-wheat composite flour in cakes and biscuits. International Journal of Nutrition and food sciences, 2013; 2(5): 232-236.
32. Onwuka GI. Food Analysis and Instrumentation: Theory and Practice. Naphthali Print, Lagos, 2005; 133-137.
33. Ojinnaka A, Adeyeye I, Asaolu S, Aluko O. Amino acid composition of two masticatory nuts (Cola acuminate and Garcinia kola) and a snack nut (Anacardium occidentale). Int J Food Sci Nutr, 2016; 58: 241–249.
34. Taiwo S, Ayodele A, Olajide J. Quality evaluation of cookies from wheat and breadfruit composite flour. Annals. Food Science and Technology. Nigerian Food Journal, 2015; 25: 15-17.
35. Ajani AO, Oshundahunsi OF, Akinoso R, Arowora KA, Abiodun AA, Pessu PO. Proximate Composition and Sensory Qualities of Snacks Produced from Breadfruit and cocoyam flour. Global Journal of Science Frontier Research Biological Sciences, 2012; 7-12.
36. Oluwamukomi MO, Oluwalana IB, Akinbowale OF. Physicochemical and Sensory Properties of Wheat-Cassava Biscuits Enriched with Soy Flour. African Journal of Food Science, 2011; 5(2): 50-56.
37. Hassan H, Okoli E. Nutritional evaluation of cookies produced from blends of pigeon peas, cocoyam and sorghum flour blends. Afr J Biotechnol, 2012; 10: 433–438.
38. Kleinman CT, Daniel JP. American cookies and health for preschool children. American Journal of Clinical Nutrition, 2009; 17: 421–526.

39. Nzeagwu OC, Onuwudiwe ET. Nutrient composition and sensory properties of tiger nut (Cyperus esculentus) biscuit. Nigerian Journal of Nutritional Sciences, 2016; 37(1): 157-164.
40. Ayogu RNB, Abraham GO, Nnam NN. Evaluation of Nutrient, antinutrient and phytochemicals in wheat based cookies incorporated with two cowpea species. Nigerian Journal of Nutritional Sciences, 2017; 38(1): 90-99.
41. Nanyen D, Dooshima IB, Julius A, Benbella I. Nutritional composition, physical and sensory properties of cookies from wheat, acha and mung bean composite flours. Int J Nutr Food Sci., 2016; 5(6): 401-406.
42. Ojinnaka A, Adeyeye I, Asaolu S, Aluko O. Amino acid composition of two masticatory nuts (Cola acuminate and Garcinia kola) and a snack nut (Anacardium occidentale). Int J Food Sci Nutr., 2016; 58: 241–249.
43. McWatters KH, Ouedraogo JB, Resurreccion AV, Hung YC, Phillips RD. Physical and sensory characteristics of sugar cookies containing mixtures of wheat, fonio (Digitaria exilis) and cowpea (Vigna unguiculata) flours. International journal of food science & technology, 2003; 38(4): 403-410.
44. Ubbor SC, Akobundu SUE. Quality characteristics of cookies from composite flours of watermelon seed, cassava and wheat. Pakistan Journal of Nutrition, 2009; 8(7): 1097-1102.
45. Piazza L, Masi P. Development of crispness in cookies during baking in an industrial oven. Cereal Chemistry, 1997; 74(2): 135-140.
46. Asogwa EU, Hammed LA, Ndubuaku TCN. Integrated production and protection practices of cashew (Anacardium occidentale) in Nigeria. African Journal of Biotechnology, 2008; 7(25).