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CHEMICAL COMPOSITION, PHYSICAL AND SENSORY ROPERTIESOF BISCUITS SUPPLEMENTED WITH CASHEW POMACE FLOUR

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ABSTRACT

The cashew pomace flour was used to substitute 5, 10,15,20,30 and 50% wheat flour in biscuits which were evaluated for the chemical, physical and sensory properties. The 100% cashew pomace flour biscuits occupied more volume but had less density and spread ratio than the 100% wheat flour biscuit. The wheat/cashew pomace flour biscuits were not significantly different ($P>0.05$) in weight, length, width, height, density and spread ratio. Biscuits containing up to 10% cashew pomace flour were not significantly different ($P>0.05$) from the 100% wheat flour biscuit in all the sensory attributes assessed. The biscuit containing 10 % cashew pomace had lower moisture (10%) and crude protein (4.5 %) but higher ash (1.7%), crude fat (17%), crude fibre (3.1%) and carbohydrate contents than the 100% wheat flour biscuit. The 100% wheat flour biscuit contained 7, 12 and 62.67% moisture, crude protein and carbohydrate, respectively

Keywords: Cashew, pomace, bread, composition, physical evaluation, sensory quality

INTRODUCTION

Many types of waste are generated during production, distribution, preparation and consumption of foods. These wastes range from 8 to 65% of the raw material (Erkssion, 1978). Food wastes create disposal and pollution problems and contribute to loss of valuable biomass and nutrients (Erkssion, 1978).However, several byproducts of plant foods are recycled and utilized in the food industry after appraisal of their chemical composition and functional properties. Mango seeds, neem seed cake, tomato seeds; orange seed, pulp and peel, African apple kernel (Akpata and Akubor, 1999; Arogba, 2000; 2012; 2014) have been extensively studied for possible utilization in human and animal diets. Cashew apple pomace has not been evaluated for this purpose. Cashew (*Anacardium occidentale***)** tree is ranked second only to almond among the nine tree nuts that is of importance in the world trade. The cashew tree produces cashew apple which is attached to the cashew nut. The weight of cashew apple is about 5 to 10 times the weight of the nut, corresponding to a world annual production of between 2.5 and 5 million tonnes of fruit (Ohler, 1979). The nut is processed into kernel which is used for various food products. However, use of cashew apple is of minor economic importance, the greater part being wasted (Ohler, 1979). Products processed from cashew apple on experimental basis or on home scale include fruit paste, candied fruit, canned fruit, jam, jelly, juice, wine and vinegar. The residue after expression of juice from the apple is called cashew pomace. Cashew pomace has been reported to contain 72% moisture, 2.3% protein, 10.9% carbohydrate, 1.4% fat, 1.5% crude fiber, 1.1% ash, calcium, phosphorus and iron (Kermatt, 2000). In several countries, including India, fresh cashew pomace is used to feed pigs. However, Aderiye *et al*. (1991) suggested that the pomace could be processed into flour and used as one of the ingredients in food and animal feed formulations. Similarly, Layokun *et al*. (1986) reported producing high quality single cell protein from cashew pomace.

The increasing growth of cashew nut processing industries world-wide and the consequent availability of large quantities of cashew pomace justify the need to determine the potential of cashew pomace for human and animal diets. Cashew pomace adequately processed into flour could be used in similar manner other flours from plant by-products are used (Arogba, 2012; 2014). However, for efficient utilization and acceptance of cashew pomace flour, studies on its desirable functional properties are important. Functionality as applied to food ingredients is any property on which the utility of foods depends. However, the final test of the functionality of cashew pomace flour is to incorporate it into a food product. Therefore, this study was undertaken to evaluate the quality of biscuits supplemented with cashew pomace flour.

MATERIALS AND METHODS

Healthy, mature and ripe cashew (*Anacardium occidentale*) fruits were harvested from a local farm in Idah Township, Kogi State, Nigeria. The fruits were stored in a refrigerator (10^0C) prior to use.

Preparation of cashew pomace flour

The fruits were sorted and washed in enough tap water contained in a basin. The nuts were removed and the juice was extracted from the apple by squeezing. The cashew pomace was cut into thin slices (2 cm thick), blanched in 1% (w/v) sodium metabisulphite solution at 100^0C for 10 min, drained and then oven dried at 50^0C to constant weight. The dried slices were milled in attrition mill, sieved through 60 mesh sieve (British standard), packed in high density polyethylene bags (HDPE) bags and stored in a refrigerator at 10^0C prior to use.

Flour blending

The cashew pomace flour was used to substitute 5, 10, 15, 20, 30 and 50% wheat flour in a food blender operated at full speed (1200 rpm) for 5 min. The flour blends were packed in HDPE bags and stored in refrigerator prior to use.

Preparation of biscuits

The method of biscuit making described by Nishibori and Kwawashiki (1990) was employed. The ingredients used were 49.5% flour, 20% margarine, 10% homogenized whole egg, 20% sugar and 0.5% baking power. The ingredients were thoroughly mixed and kneaded. The dough was cut into 18 g portions and put in greased (with margarine) pans. The pans containing the doughs were charged into the oven and baked at 160^0C for 20min. The biscuits were cooled to ambient temperature (30 ± 2^0C) and then packed in HDPE bags. The 100% wheat flour biscuits were used as control.

Evaluation of physical characteristics of biscuits

The length, breadth and height of biscuits were measured using vernier caliper. The weight was determined using digital balance. Volume of biscuit was determined by seed displacement (Akubor and Ishiwu, 2013). Density was calculated as mass/volume. Spread ratio was calculated as length/height. Percent spread was calculated as spread ratio of test biscuit/spread ratio of control biscuit x 100 (Nishibori and Kwawashiki, 1990). Measurements were made on three replicates and mean values were reported.

Sensory evaluation of biscuits

The biscuit samples including 100% wheat flour biscuit were evaluated for color, taste, flavor, texture and overall acceptability on 5-point Hedonic scale (1=dislike extremely and 5 = like extremely) (Ihekoronye and Ngoddy,1985). The biscuits were evaluated by twenty trained panelists randomly selected from students and staff of the Department of Food Science and Technology, Federal Polytechnic, Idah, Kogi State, Nigeria. The biscuits were presented to panelists in 3-digit coded plastic plates. The order of presentation of biscuits to the panelists was randomized. The sensory evaluation was carried out in a sensory evaluation laboratory under white light and adequate ventilation. Clean tap water was provided for panelists to rinse their mouths in between evaluations.

Evaluation of chemical composition

Moisture was determined by hot air oven drying at 105ºC to constant weight (AOAC, 2010). Ash, protein (micro-Kjeldahl, N x 6.25), crude fiber and crude fat (solvent extraction) were determined by the AOAC (2010) methods. Calorie was calculated using Atwater factors of 4 x % protein, 4 x % carbohydrate and 9 x % crude fat and then taking the sum.

Statistical analysis

Data were analyzed by analysis of variance in completely randomized design using Statistical Package for Social Sciences (SPSS) (version, 20) software. Means where significantly different were separated by the least significant difference (Lsd) test (Steel and Torrie, 1980). Significance was accepted at $P < 0.05$.

RESULTS AND DISCUSSION

Physical properties of biscuits

The physical properties of biscuits prepared from wheat flour, cashew pomace flour and the blends are shown in Table 1. The 100% wheat flour biscuits (22.41 g) had higher weight than the 100% cashew pomace flour biscuit (18.53 g). The weight of biscuits containing cashew pomace flour ranged between 18.17 and 19.41 g, values being lower than that of the 100% WF biscuit. Shittu *et al*. (2007) reported the basic determinant of weight of baked products to be quantity of dough baked and the amount of moisture and carbon dioxide that diffused out of the product during baking. The low weight of cashew pomace based biscuits may be explained by the water absorption property of cashew pomace flour. Both wheat flour and cashew pomace flour absorbed water, but during baking, cashew pomace flour lost water more readily than wheat flour WF. The high bulk density of wheat flour may account for the weight of wheat flour biscuit. Badifu *et al*. (2000) also attributed increase of loaf weight to high moisture, in addition to nature of carbohydrate and high bulk density of flour. The length, width and height of biscuits prepared from 100% cashew pomace flour, 100% wheat flour and their blends were not significantly ($p>0.05$) different. However, the 100% wheat flour biscuit occupied less volume with higher density than the 100% cashew pomace flour biscuit. The volume of the biscuits increased with the level of cashew pomace flour in the blends. The 100% wheat flour biscuit had spread ratio of 6.5 with 100% spread ratio. The 100% cashew pomace biscuit on the other hand, had spread ratio of 4.33, representing 79% of the biscuit spread. The spread ratios of the biscuits containing cashew pomace flour varied from 4.8 to 5.20, with percent spread ratio in the range of 84.4 to 95%. The low spread ratio of cashew pomace flour biscuits relative to wheat flour biscuit may be due to the high water absorption capacity of cashew pomace flour. Enwere (1989) suggested that biscuit spread is affected by competition of ingredients for available water. Flour or any other ingredient, which absorbs water during dough mixing, will reduce biscuit spread. However, it also appears other functional properties may also affect spread.

Table 1. Physical properties of biscuits supplemented with cashew pomace flour

Parameter	Biscuits							
	CPF: WF							
	0:100	100:0	5:95	10:90	20:80	30:70	40:60	50:50
Weight (g)	22.41^a	18.53^b	18.17^b	18.38^b	18.31^b	19.27^a	19.0^a	19.10^a
Length (cm)	6.5^a	6.5^a	6.5^a	6.0^a	5.5^a	5.2^a	4.3^a	4.8^a
Width (cm)	3.5^a	3.0^a	3.5^a	3.0^a	2.8^a	2.5^a	2.1^a	2.0^a
Height (cm)	1.5^a	1.0^a	1.4^a	1.3^a	1.1^a	1.0^a	1.0^a	1.0^a
Volume (cm3)	19.03^c	4.0^h	31^a	23.0^b	18.1^d	12^e	10^g	11^f
Density (g/cm3)	1.8^a	0.54^a	0.57^a	0.79^a	1.2^a	1.5^a	1.6^a	1.7^a
Spread ratio	6.50^a	4.33^c	4.6^c	4.6^c	5.0^b	5.2^b	5^b	4.8^c
Spread ratio (%)	100^a	79^f	84^e	48^g	91^c	95^b	92^c	87.3^d

Values are means of 3 replications. Means within a column with the same superscript were not significantly different ($P < 0.05$).

Sensory properties

The sensory properties of the biscuits are shown in Table 2. The biscuits containing 100% wheat flour received higher ratings than the other biscuits in all the sensory attributes assessed, probably because wheat flour is conventionally used to prepare biscuits. The biscuit prepared with 100% cashew pomace flour was rated lowest in all the sensory attributes, implying rejection by the panelists. Thus, 100% cashew pomace flour would not produce acceptable biscuits. Scores for all the sensory attributes steadily decreased with increased level of cashew pomace flour in the biscuits. However, biscuits containing up to 10% cashew pomace flour were not significantly different ($P<0.05$) from the 100% wheat flour biscuit (control) in the sensory attributes studied. Visually, the color of the 100% cashew pomace flour biscuit was dull brown compared to golden brown for the 100% WF biscuit. The color of the 100% cashew pomace flour may have been contributed by phytochemicals in cashew pomace flour which would potentially increase the health benefits of the biscuits. The cashew pomace flour probably provided additional reducing sugars for Maillard browning to occur, thus, biscuits containing cashew pomace flour were darker than the biscuits that did not contain cashew pomace flour. The 100% cashew pomace flour biscuits received the lowest score for taste probably due to the presence of phytochemicals which have bitter taste in the pomace.

Table 2. Sensory properties of biscuits supplemented with cashew pomace

Biscuits	Colour	Taste	Flavour	Texture	Overall acceptability
CPF: WF					
0:100	4.2^a	4.2^a	4.0^a	4.5^a	4.3^a
100:0	1.2^d	1.8^c	1.9^d	2.1^c	1.7^d
5:95	3.9^a	3.9^a	3.9^a	3.8^a	4.0^a
10:90	3.6^a	3.7^a	3.9^a	3.8^a	4.0^a
15:85	3.2^b	3.6^a	3.4^b	3.4^a	3.5^b
20:80	2.8^b	3.6^a	3.5^{ab}	3.7^a	3.6^b
30:70	3.0^b	3.6^a	3.5^{ab}	3.7^a	3.6^b
40:60	2.5	2.4^b	2.2^c	2.7^c	2.5^c
50:50	2.0^c	2.1^b	2.3^c	2.3^c	2.5^c

Means (n=20) within a column with the same superscript were not significantly different (P>0.05). Biscuits were evaluated on 5-point Hedonic scale (1=dislike extremely and 5= like extremely).

The differences in flavor quality were not significant (P >0.05) for the biscuits containing up to 30% cashew pomace flour and the 100% wheat flour biscuit. However, the biscuit containing 100% cashew pomace flour was significantly (P <0.05) lower in the flavor score. The panelists noted greater cashew pomace flavor in biscuits containing high amounts of cashew pomace flour. At such high levels, non wheat aftertaste became noticeable in the biscuits. High levels of wheat flour masked the flavor contributed by the cashew pomace flour. The scores for texture followed similar trend as the color .Texture is a crucial characteristic of biscuits. Addition of cashew pomace flour reduced scores for texture. Relative to the other levels of inclusion, the biscuits containing up to 10% cashew pomace flour were not significantly different (P >0.05) in texture from the 100% wheat flour biscuit. As the level of incorporation of cashew pomace flour increased, biscuits became less cohesive and more crumbly. As wheat substitution level increased, gluten proteins, responsible for cohesiveness or structure of baked products, were reduced and the formation of gluten probably interfered with the development of gluten complex. The biscuits containing up to 10% cashew pomace were acceptable to the panelists, with overall acceptability score not significantly different (P>0.05) from that of the 100% wheat flour biscuits.

Proximate composition of biscuits

The data in Table 3 present the proximate composition of the biscuit supplemented with cashew pomace flour. The biscuits containing 10% cashew pomace flour had lower moisture, fat and protein but higher ash, fiber and carbohydrate contents than the 100% WF biscuits. The ash, fiber and carbohydrate contents of the biscuits containing 10 % cashew pomace flour were 1.7, 3.2, 67.6%, respectively while the ash, fiber and carbohydrate contents of wheat flour were 1.2, 1.2 and 62.6 %, respectively. On the other hand, wheat flour biscuit contained higher moisture (7%) and protein (12%) than the cashew pomace based biscuits where the moisture and protein contents were 6 and 4.5 %, respectively. The higher levels of ash, fiber and carbohydrate in the supplemented biscuits could be attributed to the high contents of these constituents in cashew pomace flour (Aderiye *et al.*,1991).Fruit pulps are not good sources of fat (Enwere, 1989). The low level of fat in the biscuits would enhance storage stability as they are unlikely to develop rancidity if adequately packaged. The moisture contents of the biscuits were within the limit of not more than 10% suitable for stable storage of baked products (Onimawo and Akubor, 2012). Mold growth and moisture dependent biochemical reactions are reduced in low moisture foods on storage. Moisture content above 15% was reported to cause mold growth in foods (Onimawo and Akubor, 2012). The results of this study clearly indicated that cashew pomace based biscuit was a good source of fiber. The high level of crude fiber in cashew pomace flour based biscuit could be of potential usefulness. The therapeutic effects of fiber in prevention of heart diseases, colon cancer and diabetes and their role in the treatment of digestive disorders (diverticulosis) and constipation are widely documented (Anderson *et al.*,1994).

Table 3: Proximate composition of biscuits supplemented with cashew pomace flour

Parameter (%)	Biscuits	
	Wheat flour	Cashew pomace/wheat flour
Moisture	7.0 ± 0.09^a	6.0 ± 0.10^b
Ash	1.2 ± 0.10^b	1.7 ± 0.07^a
Crude protein	12.0 ± 0.04^a	4.5 ± 0.03^b
Crude fat	16.0 ± 0.09^b	17.0 ± 0.04^a
Crude fiber	1.2 ± 0.07^b	3.2 ± 0.08^a
Carbohydrate	62.6 ± 0.01^b	67.6 ± 0.05^a

Means ± SD of 3 replications. Means within a row with the same superscript were not significantly different (p< 0.05). Cashew pomace flour (CPF) /Wheat flour(WF) biscuit contained 10% CPF and 90% WF

CONCLUSION

The present data demonstrated that it is possible to add up to 10% cashew pomace flour in biscuits without adversely affecting the physical and sensory properties of the biscuits. With increasing demand for fiber rich biscuits, it is likely that cashew pomace flour would become more important in the biscuit industry. More studies should be conducted on the use of cashew pomace as ingredient in other food products in order to increase applications of such value-added food ingredient

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