CAKE PRODUCTION FROM WHEAT (*TRITICUM AESTIVUM*) AND COWPEA (*VIGNA UNGUICULATA*) FLOURS USING DATE FRUIT AS A SWEETENER

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Abstract
Changes in consumer demand for new pastries due to the high rate of diabetes, obesity and celiac disease are causing an unprecedented spur in the processing and ingredient system developments within the pastry production sector. Consumers demand healthier pastries that are low in sugar, fat, cholesterol, and calories in general and contain in addition health-promoting components such as protein, unsaturated fatty acids, and fibres. This project reports the proximate, mineral, functional and sensory characteristics of cakes produced from blends of wheat and cowpea flour using date as a sweetener. Six cake samples were produced with different formulations which include wheat flour and sugar (WHS), wheat flour and date fruit extracts (WHD), composite flour of wheat and cowpea in the ratio 50:50 with sugar (COS) and dates respectively (COD) and cowpea flour with sugar (CWS) and date fruit extracts (CWD) respectively. The protein content of the wheat, cowpea and composite flours ranged from 14.20-15.37%, moisture; 4.76-5.58%, ash; 0.52-0.53, crude fat; 0.99-1.53%, crude fibre; 0.20-0.23% and carbohydrate; 77.42-78.45%. The loose bulk density, packed bulk density, water absorption capacity and oil absorption capacity had a range of 0.45-0.50g/mL, 0.68-0.73g/mL, 0.76-2.06g water/g flour and 0.70-1.20g oil/ g flour respectively. The proximate composition of the cakes varied significantly with cake produced from cowpea sweetened with sugar having the highest protein content and cake from wheat flour sweetened with date having the lowest. Generally, cakes produced from composite flour sweetened with sugar had higher contents of calcium than cakes sweetened with dates while the iron and potassium contents were higher in cakes sweetened with date extract. Cakes produced with sugar as the sweetener had better ratings than those with date fruit, however, all the cakes compared favourably well with the control (cake produced from 100% wheat flour sweetened with sugar) in all the parameters measured.

Keywords: Quality, Cake, Cowpea, Wheat, Date

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1.INTRODUCTION

Cakes are convenient food products (Atef *et al*., 2011). They are usually sweet and often baked, prepared from flour, sugar, shortening, baking powder, egg, and essence as principal ingredients (Clerk and Herbert 2000; Atef *et al*., 2011). Wheat is the major flour used in cake production. Tull (2000) reported that cake produced from wheat flour alone lack adequate protein needed for growth, repair of tissues and building of cells. In addition, cake made from wheat flour is too expensive for an average person from a developing country to afford. This has greatly influenced the use of composite flours in which flours from locally grown crops and high protein seeds replace a portion of wheat flour for use in bread and other pasties production, therefore decreasing the demand for imported wheat and increasing the production of protein-enriched bread and pasties (Giami et al.,2004; Olaoye *et al*.,2006). Literatures abound on the use of composite flours in the production of cake. Atef *et al*., (2011), reported the use of fava beans and cowpea flour in the production of gluten-free cake to combat the prevalence of autism and celiac disease (CD), an intolerance of gluten, which has been reported to be as high as one in 200 of the world population (Fasano and Catassi 2001). The use of wheat-based composite flours in the production of cookies (Ajanaku *et al*., 2011; Kamaljit *et al*., 2010; Nasir *et al*., 2010; Onoja *et al*., 2010; Gernah et al., 2010; Arshad *et al*., 2007; Giami *et al*., 2005; Mc Watters *et al*., 2003; Shrestha and Noomhorm, 2002) have also been reported.

Sanful *et al.*, (2010) reported that cakes made from wheat-soya beans flour were more acceptable than whole wheat flour cake and the nutritional contents increased as the amount of soya beans increased. The production of cake from wheat, soya beans and cassava flour have also been reported (Ugwuona *et al.*, 2012). These authors reported that cakes produced from composite flour blends were higher in protein, carbohydrates and fat contents than those made of 100% wheat flour.

In Nigeria, the consumption of cake is high, as celebrations takes place weekly across the country and thus, the consumption the consumption of wheat flours. Attempts to remove the gluten ingredients in foods may result in the loss of nutritional balance (Mariani *et al.*, 1998; Grehn *et al.*, 2001).

Wheat flour has also been known to be expensive in Nigeria compared to other cereals mainly because it is not produced locally, however, there are so many other crops grown in Nigeria and attempts have been made by many researchers to complement wheat flours with non-wheat flours particularly legumes flour for pastry products (Okaka and Isieh, 1990; Onweluzo *et al*., 1995). Onwuka *et al.*, (2005) reported that acceptable cakes could be produced from wheat flour substituted with up to 50% of plantain flours.

The active ingredients of cake such as wheat flour, sugar and fat have been known to be linked to health related problems like the celiac disease, diabetes and obesity respectively. One way to solve this problem is to seek alternative sources of flour and sweeteners in cake production. For example, using cowpea flour as a replacement for wheat flour and date fruits as a sweetener will further enhance the use of cowpea and date fruit, and thus increase the consumption of gluten and sugar free cake. Further it may contribute to the control of these diseases (celiac, diabetes and obesity) which is prevalent in many developing countries. Cowpea is one of the richest and inexpensive sources of plant protein used in the improvement of the diet of individuals that are poor and those with low income particularly in both developed and developing countries of the world (Enwere, 1998). Cowpea appears to be the most popular among the legumes consumed in Nigeria because it can easily be utilized in many food preparations (Okoye and Okaka 2009). It can be processed into paste, flour; protein isolates and concentrates which can be used for the preparation of various food products (Okaka and Potter, 1979; Ngoddy *et al*., 1986; Enwere and Ebiogwu, 1993). The consumption of beans in Nigeria and some other parts of West Africa is influenced by the nutritional composition, taste, cost and availability among others. A recent study on the comparative analysis of brown and white beans showed that brown beans contain higher proteins, calcium, potassium and zinc than white beans (Alayande *et al*., 2012). This may be one of the reasons why many people consume brown beans than white beans.

Date fruits are important commercial crop in the Middle East with a high percentage of carbohydrate, fat; comprising 14 types of fatty acids, 15 salts and minerals, protein with 23 different amino acids, six vitamins and a high percentage of dietary fibre (Walid *et al.*, 2003).

There is little or no information on the use of date fruit as a sweetener in cake produced from cowpea and wheat composite flours, therefore, this study aims at investigating the possibilities of using date fruit as a sweetener in the production of cake from cowpea and wheat composite flour.

2. MATERIALS AND METHODS

Whole wheat flour, cowpea (white species), date fruits, sugar, egg, shortening, nutmeg and baking powder were purchased in Ilorin, Nigeria.

Production of cowpea flour

The cowpea flour was prepared according to the method described by Okaka (1997) with some modifications. Cleaned cowpea seeds were weighed, cleaned and soaked in potable water for 20 minutes. Thereafter, the seeds were drained, dehulled manually, boiled (100°C for 30min) and dried in oven of 65°C for 6hrs). The dried seeds were milled, sieved

and packaged in polyethylene bags until analysis.

Preparation of composite flour blends

Composite flour was prepared by mixing wheat flour and cowpea flour (1:1) in a B8 universal mixer (IPX1, 7076) at 550 rpm for 20 mins. The resulting blends were packaged in polyethylene bags and used immediately in cake production.

Production of date extract

Date was extracted using method described by Fennir *et al*., (2003)

Production of Cake

Cakes were prepared by mixing the following ingredients 500 g flour, 200 g sugar, 250 g shortening, 4 g baking powder, 4 eggs, and a teaspoonful of vanilla flavour. Sugar was mixed with shortening and egg albumin added. The mixture was whipped for 30 mins and other ingredients added and mixed. The mix was poured into baking pans, and samples were baked at 170^{o}C for 15 mins. Date fruit extract (200g) was used to replace sugar as a sweetener (Atef *et al*., 2011).

Quality Evaluation

Determination of proximate composition of flours and cake

Proximate composition (moisture content, protein, fat, fibre, ash and carbohydrate) of the wheat, cowpea flours and cake were determined using methods described by AOAC, (1990).

Determination of bulk density

The method of Mpotokwane *et al*. (2008) was adopted for the determination of bulk density with slight modification. A measuring cylinder (100mL) was filled with flour to mark (100mL), and the content weighed. The tapped bulk density was also obtained by following the same procedure but tapping for 50 times prior to weighing. Bulk density was calculated as the ratio of the bulk weight and the volume of the container (g/mL) (Asoegwu*et al.* 2006).

Determination of Water and oil Absorption Capacity

Water and oil absorption capacity of the flour were determined following methods of Sosulski *et al*., (1976). One gram of flour sample mixed with 10 mL distilled water and 10 mL of refined soybean oil (sp.gravity 0.9092) for water and oil absorption capacity respectively. The mixture was allowed to stand at room temperature for 30 min and then centrifuged (Philips Drucker, Oregon, USA) at 2000g for 30 min. Water absorption capacity was expressed as gram of water bound per gram flour and oil absorption capacity as gram of oil bound per gram flour.

Determination of Mineral Content

Mineral analysis was performed using the procedure described by the AOAC (1990). The analytical procedures used for sample treatment for Atomic Absorption Spectroscopy analysis were as follows: 1g of the sample weighed into a pyrex glass conical flask. 10ml concentrated nitric acid was introduced into the flask with a straight pipette. 5ml of perchloric acid was also added. The mixture was then heated on an electro-thermal heater for a period of 20 minutes until a clear digest was obtained. The digest was cooled to room temperature and diluted to 50ml with distilled water. The diluents were filtered into a plastic vial for AAS analysis of calcium, iron and potassium.

Sensory Evaluation

Cakes were allowed to cool on racks for about 30 minutes and organoleptically estimated for the quality attributes by selected semi-trained panellists drawn among the students of the Department of Home Economics and Food Science, University of Ilorin. Each sample was rated on perceived intensities of standard sensory attributes (Taste, Colour, flavour, Texture and General Acceptability) using a 9-point hedonic scale with 1 as disliked extremely and 9 as liked extremely.

Statistical Analysis

All analyses were conducted in duplicates. Data were subjected to analysis of variance, and Duncan multiple range test was used to separate the means (Duncan, 1955).

3. RESULTS AND DISCUSSION

Proximate Composition of Wheat-Cowpea Flours

The proximate composition of the flours used in the production of cake is presented in Table 1. Cowpea flour (100%) had higher protein (15.55%) and crude fat values than wheat flour and composite flour. Ash and crude fibre content of all the flours are not significantly different ($p \leq 0.05$). Wheat flour had higher moisture content (5.58%) and carbohydrate content (78.45%). Although, the proximate composition of the cowpea and composite flours did not vary significantly ($p \leq 0.05$), cowpea flour had higher proximate values than those reported by Alayande *et al*., (2012) and Sanful *et al*., (2010) but lower than the value reported by McWatters (1983) and Olapade *et al*., (2004). The variation observed may be attributed to difference in cultivar used and possibly the processing methods employed. The proximate composition of the wheat flour is comparable with values reported by Atef *et al*., (2011). Higher protein content of cowpea flours is expected since they are rich sources of protein.

Functional Properties of Wheat-Cowpea Flours

The functional property of foods determines the application and the use of food materials for various food products (Adeleke and Odedeji, 2010). Both loose bulk density (LBD) and packed bulk density (PBD) of the flours varied significantly (Table 2). The LBD ranged between 0.45 and 0.50g/mL, while the PBD ranged between 0.68 and 0.73g/mL for wheat flour and composite flours respectively. Composite flour showed significantly higher LBD and PBD than wheat and cow pea flour. The relatively lower densities (LBD and PBD) observed in both cowpea flour and wheat flour may be attributed to difference in the particle size and to total or partial gelatinization of the flours during drying (Falade and Olugbuyi, 2010). On the other hand, higher bulk densities of the composite flour demonstrate greater compactness and possible mixed effect caused by the interaction of the molecules of the cowpea flour and wheat flour. The higher bulk density observed for the composite flour implies that a denser packaging material may be required for this product. Bulk density gives information on the porosity of a product and can influence the choice of package and its design (Odedeji and Oyeleke, 2011).

Similarly, the composite flour had higher water absorption capacity (WAC) and oil absorption capacity (OAC) than cowpea and wheat flour (Table 2). Further, WAC of all the flours was higher than OAC. However the WAC and OAC of cowpea flour were comparable to that of the composite. The difference observed in WAC among the flours may be attributed to the quantity of damaged and undamaged starch present within the flours (Asiedu, 1989). Variation in particle size distribution may also have influenced the WAC. This is plausible because Adeyemi and Beckley (1986) reported that water absorption capacities of flours correlate positively with the particle size of flours. Higher WAC of the composite flour may be attributed to their higher protein contents. Afoakwa, (1996), reported that proteins are mainly responsible for the bulk of water uptake in flours and to a lesser extent starch at room temperature. The higher OAC observed for composite and cowpea flour may be attributed to their higher protein content (Table 1) Protein type and amount has been reported to contribute to the oil retaining properties of food materials. Wan and Kinsella, 1991 also attributed the mechanism of oil absorption to physical entrapment of oil and the binding of fat to a nonpolar chain of protein. Low OAC is highly desirable for flour products since they can influence the acceptability of the products by potential consumers. OAC of flours is also important for the development of new food products and influences to a great extent their storage stability (Falade and Kolawole 2011).

Proximate Composition of Wheat-Cowpea Cakes

The proximate composition of cakes produced from wheat flour, cowpea flour and their composite as presented in Table 3 varied

Table 1: Proximate composition of Wheat-Cowpea flours

Sample	Moisture (%)	Ash (%)	Crude Protein (%)	Crude Fat (%)	Crude Fibre(%)	Carbohydrate (%)
Wheat (100%)	5.58±0.09^{a}	0.53±0.005^{a}	14.20±0.005^{b}	0.99±0.64^{b}	0.22±0.02^{a}	78.45±0.16^{a}
Cowpea (100%)	4.76±0.26^{b}	0.52±0.001^{a}	15.55±0.21^{a}	1.53±0.17^{a}	0.20±0.01^{a}	77.42±0.08^{b}
Composite (50:50)	4.77±0.22^{b}	0.53±0.02^{a}	15.37±0.15^{a}	1.52±0.15^{a}	0.23±0.01^{a}	77.57±0.35^{b}

Mean with the same superscripts along the column are not significantly different from each other ($p \leq 0.05$)

Table 2: Functional properties Wheat-Cowpea flours

Sample	Loose Bulk Density (g/mL)	Packed Bulk Density (g/mL)	Water absorption Capacity (g water/g flour)	Oil Absorption Capacity (g oil/g flour)
Wheat	0.45^{c}	0.68^{b}	0.76^{b}	0.70^{b}
Cowpea	0.47^{b}	0.69^{b}	2.00^{a}	1.13^{a}
Composite(50:50)	0.50^{a}	0.73^{a}	2.06^{a}	1.20^{a}

Mean with the same superscripts along the column are not significantly different from each other ($p \leq 0.05$)*****

Table 3: Proximate composition of Wheat-Cowpea cakes

Sample	Moisture (%)	Ash (%)	Crude Protein (%)	Crude Fat (%)	Crude Fibre (%)	Carbohydrate (%)
WHD	22.37±0.06^{a}	2.23±0.16^{b}	11.20±0.16^{bc}	18.09±0.1^{a}	0.89±0.07^{b}	44.85±0.41^{b}
WHS	21.86±0.26^{ab}	2.66±0.29^{a}	11.54±0.12^{abc}	18.18±0.33^{a}	1.01±0.1^{ab}	45.06±0.70^{b}
CWD	22.51±0.87^{a}	1.96±0.18^{bc}	11.41±0.03^{abc}	17.13±0.13^{bc}	1.06±0.07^{a}	47.28±1.17^{a}
CWS	22.14±0.8^{a}	2.03±0.08^{bc}	11.76±1.31^{ab}	17.69±0.34^{b}	1.04±0.07^{a}	44.95±1.55^{b}
COD	22.65±0.36^{a}	1.83±0.30^{bc}	11.64±0.37^{ab}	17.85±0.36^{a}	1.02±0.01^{a}	46.11±0.58^{a}
COS	21.62±0.35^{ab}	1.78±0.17^{c}	12.43±0.04^{a}	16.91±0.57^{c}	1.06±0.04^{a}	46.15±0.94^{ab}

Mean with the same superscripts along the column are not significantly different from each other ($p \leq 0.05$)

WHD: 100% wheat +date
WHS: 100% wheat + sugar
COD: 50%wheat; 50%cowpea + date
COS: 50%wheat; 50%cowpea + sugar
CWD: 100% cowpea + date
CWS: 100% cowpea + sugar

significantly ($p \leq 0.05$) with a range of 21.62-22.65%, 1.78-2.66%, 11.20-12.43%, 16.91-18.18%, 0.89-1.06% and 44.85-47.28% for moisture, ash, protein, crude fat, crude fibre and carbohydrate respectively. Cake produced from 100% wheat sweetened with date had the highest moisture content, while cake produced from composite flour sweetened with sugar had the lowest. The type of sweetener (date or sugar) used in the production of cake did not affect the moisture content of the cakes significantly. The moisture content of the cakes are higher than those reported by Sanful *et al*., (2010) for cakes produced from wheat-soybean composite flour but lower than values reported by Rahut *et al*.,(2012) for cakes produced from wheat, rice and chick pea composite flour enriched with Palmyra palm.

Cake produced from 100% wheat flour sweetened with sugar had the highest ash content while cake from composite flour sweetened with sugar had the lowest. The ash content of all the cakes sweetened with sugar was higher than cake sweetened with date fruit extract except for cakes produced from 100% cowpea flour. Generally, protein content in each category (100% wheat, 100% cowpea and the composite flours) did not vary significantly with the type of sweetener used. Cake produced from 100% cowpea flour sweetened with sugar had the highest protein content while cake from 100% wheat flour sweetened with date had the lowest value. The high protein content of the cake produced from 100% cowpea flour may be attributed to the relatively high protein content of cowpea.

The fibre contents of all the cakes were not significantly different ($p \leq 0.05$) except for wheat flour-sugar-sweetened cake (0.89%). Higher crude fibre contents of the cakes, in comparison with the flours may have resulted from the sweeteners used.

This results indicates that substituting wheat with cowpea can be used to improve the nutritional properties of cakes especially protein, fat and crude fibre which is of health benefits to consumers because Protein is needed for physiological functioning and reducing protein-energy malnutrition; crude fibre is anti- diabetic while vegetable fat is a good source of energy and helps in absorption of most fat soluble vitamins and minerals (WHO, 2004; Okaka and Isieh 1990).

Mineral Composition of Wheat-Cowpea Cakes

Cakes produced from cowpea flour, composite flour and wheat flour sweetened with sugar showed high contents of calcium (5.29, 5.27 and 4.71mg/100g) respectively. This may be due to the high amount of calcium contained in cowpea. However, the value of iron and potassium increased in cakes sweetened with date extract; Fe (0.42, 0.41 and 0.41mg/100g), K (2.05, 2.03 and 2.01mg/100g). The increased value of iron suggests that the cakes may be used in prevention and control of anaemia. Minerals are required for normal growth; cellular activity and oxygen transport (Fe), fluid balance and nerve transmission (K) as well as the regulation of blood pressure and strengthening of bones (Ca and K).

Sensory Evaluation

The mean sensory scores for cakes produced from wheat and cowpea flour are presented in Table 4. Cakes produced from wheat and cowpea flour blends (50:50) sweetened with sugar had the highest ratings for taste, colour and texture. The differences in ratings for taste, colour and texture are not significant ($p \leq 0.05$). Cakes made from wheat flour had comparable values with cake produced from composite flour sweetened with sugar. This indicates that sugar has a strong impact on these sensory parameters. Cakes made from wheat flour sweetened with sugar and date had the highest preference in aroma while cakes from composite flour and date had the least. On the whole, cakes produced from cowpea flour sweetened with date had the least ratings for colour, taste and texture and cakes produced from composite flour (cowpea and wheat flour) sweetened with date had the least ratings for aroma and general acceptability.

Table 4: Mineral composition of Wheat-Cowpea cakes

Sample	Ca (mg/100g)	Fe (mg/100g)	K (mg/100g)
WHD	4.21±0.03^{e}	0.41±0.002^{b}	2.01±0.02^{b}
WHS	4.71±0.02^{c}	0.31±0.001^{d}	1.93±0.03^{c}
CWD	4.25±0.01^{d}	0.41±0.003^{ab}	2.05±0.01^{a}
CWS	5.27±0.03^{a}	0.32±0.001^{c}	2.03±0.01^{ab}
COD	5.01±0.01^{b}	0.42±0.002^{a}	2.03±0.01^{ab}
COS	5.29±0.01^{a}	0.31±0.004^{d}	2.01±0.02^{ab}

Mean with the same superscripts along the column are not significantly different from each other ($p \leq 0.05$)

Table 5: Mean sensory scores of Wheat-Cowpea cakes

Sample	Taste	Colour	Flavour	Texture	General Acceptability
WHD	6.53^{ab}	5.33^{b}	7.07^{a}	6.20^{a}	6.40^{a}
WHS	6.87^{a}	7.20^{a}	6.67^{a}	6.73^{a}	7.33^{a}
CWD	5.60^{ab}	5.47^{b}	5.73^{a}	6.27^{a}	5.80^{a}
CWS	7.13^{a}	7.00^{a}	6.40^{a}	7.00^{a}	7.27^{a}
COD	5.00^{b}	5.00^{b}	5.80^{a}	5.60^{a}	5.87^{a}
COS	5.80^{ab}	6.07^{ab}	5.87^{a}	6.60^{a}	6.53^{a}

Mean with the same superscripts along the column are not significantly different from each other ($p \leq 0.05$)

The low ratings observed for this cake may be as a result of the beany flavour of cowpea and the relatively higher moisture contents of the date extracts. Generally, cakes produced from composite flour and wheat flour sweetened with sugar had similar and the highest ratings for general acceptability. This result shows the possibility of utilizing cowpea flour in cake production.

4. CONCLUSIONS

The production of acceptable cakes by substituting wheat flour with cowpea flour and sugar with date fruit is possible. Although the beany flavour of cowpea was a barrier, the use of cowpea contributed to the firm texture and the nutritional properties of the cake produced. Replacing sugar with date fruit extract using cowpea flour did not produce acceptable products. Cakes produced from this combination had undesirable colour, taste, texture and pungent smell deduced hours after production and this might be due to the high moisture content of the date extract. Therefore, date fruits extract should not be used with cowpea flour for cake production. The use of composite flour and sugar or wheat flour and date extract, however, is recommended to produce acceptable cakes of good quality.

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