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Full Length Research Article

PRODUCTION AND QUALITY EVALUATION OF CAKE FROM WHEAT AND RED BANANA FLOUR BLENDS

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ABSTRACT

Cakes are convenient food products prepared from flour basically wheat and other principal ingredients and often baked. This study investigated the quality of cake produced from flour blends of wheat and red banana. Cakes were produced from eight formulations of flour blends of wheat and red banana at 10-80% ratios. Cakes from 100% wheat flour served as the control. The flour blends were analysed for functional properties while the cakes were subjected to proximate, physical and sensory evaluation. Results of the functional properties of the flour blends significantly ($p<0.05$) increased with increased proportion of banana flour in all the parameters evaluated. The same trend was observed in the proximate composition of the cakes in the ash, fibre and carbohydrate contents. Amongst the physical properties (weight, height, volume) of the cakes evaluated the weights were significantly ($p<0.05$) higher in the flour blends than the control sample (100% wheat flour). The sensory evaluation showed high scores of preference and acceptance in cakes containing up to 30% banana flour and were comparable to the control (100% wheat) in all the parameters analysed. The study revealed that cake produced from wheat/banana flour blends possesses good nutrient quality comparable to the control (100% wheat flour).

Keywords: Cake, Convenient food, Flour, Red banana, Sensory.

INTRODUCTION

Cakes are relished and palatable baked products typically sweet and can be eaten in the home or served in ceremonial occasions as a special dish. They are a major snack in the fast food industry and highlight of many celebrations. Cakes are baked deserts usually made from a good number of ingredients such as flour, sugar, shortening, baking powder, egg, flavourings, nuts, chocolate and dried fruits. Flour is one of the basic ingredients for cake making (Adegbanke & Ayomiposi, 2019). There are many cake recipes and can be classified based on their accompaniment such as coffee cakes, occasion cakes, primarily on ingredients and baking techniques. Cake may be small and intended for individual consumption such as queen cake while big size cakes are cut, sliced and served as part of a meal or social functions (Adegbanke & Ayomiposi, 2019). Cakes are mainly cherished by women and children.

Composite flours have been shown to have great potentials in the production of high quality and nutritious food products and several researches have shown remarkable viability of up to 50% partial replacement of wheat flour with flours from other locally grown food crops such as roots, cereals and even nuts (Nwanekezi, 2013; Banua *et al.,* 2021).

Banana is among the most important worldwide consumed fruit product. Banana is said to be eaten as a dessert but some researchers have proven that it can be used for the preparation of drinks, wine, bakery product etc. (Debabandy *et al.,* 2010). Amongst the varieties of bananas in existence, red banana with its official botanical name red Dacca is one of the varieties with several names depending on the region it is grown, including red Spanish, Red Cuban, Colorado or Lal Kela (Manikandan *et al*., 2008). Red banana is a variety of banana which is not only energy-rich but also contains significant amounts of minerals and vitamin one of a tropical fruit grown in over 122 countries worldwide (Ehiowemwenguan *et al.,* 2014).

Wheat flour is widely used due to its gluten content which is a protein that facilitates excellent dough formation and elasticity; a characteristic feature absent in other flours (Wujun, 2019). Unfortunately, the availability of wheat is limited in some parts of the world due to the difference in climate and soil types hence, has necessitated its importation in these areas in order to meet the growing demand for cakes and baked foods as a whole. As a result, bakers face a major challenge of increased cost of production due to the importation of wheat which further translates to increased price for baked foods (Negassa *et al.,* 2013; Dambazau, *et al.,* 2021; FEWS NET, 2021). Although the gluten content of wheat gives wheat flour an edge over other flours during baking, celiac disease may be a limitation to its use as up to 1% of the world population have been diagnosed of celiac diseases and this implies a lifetime gluten free diet (GFD) is the effective treatment for this disease (Caio *et al.,* 2019).

Therefore, celiac disease and the increased cost of wheat due to its unavailability in some parts of the world have been highlighted as the two major challenges militating against the use of wheat flour in baking hence, a need for cost effective alternatives with minimal gluten content is therefore, sought (Nwanekezi, 2013; Dambazau *et al.,* 2021).

In this study, the potentials of flour blends of wheat and red banana in the production of cake were evaluated as a way of mitigating the problems associated with the economic implication of over dependence on wheat flour for baking, celiac disease, under-utilization of locally grown foods and low nutrient baked foods. The purpose of this study was to evaluate the quality of cake produced from flour blends of wheat and red banana.

MATERIALS AND METHODS

Procurement of Raw Materials

Red banana was purchased from Urua Anwa Market in Oruk Anam Local Government Area of Akwa Ibom State. The wheat grains and all the ingredients used in the production of cake were purchased from Umuahia Main Market in Abia State, Nigeria.

Preparation of wheat and red banana flours

The method described by Peter-Ikechukwu *et al*. (2017) was adopted in the production of wheat flour. The wheat grains were sorted manually to remove unwanted materials, washed (in clean water) and drained off water using a perforated plastic bowl. The clean wheat grains were oven dried (Gallenkemp, 300 Plus, England) at 60ºC for 8 h, milled using hammer mill (HMC-HM6630, China) and sieved (250 µm mesh size) to obtain fine wheat flour that was packaged in a transparent cellophane bag and stored at room temperature (23^{o}C) for further use.

The banana flour was prepared according to the method described by Kiin-Kabari *et al*. (2015). Each finger of banana was washed (in clean tap water), peeled with stainless kitchen knife, sliced (2 mm thickness), oven dried (Gallenkemp, 300 Plus, England) at 50ºC for 12 h, milled using hammer mill (HMC-HM6630, China) and sieved (250 µm mesh size) to obtain fine banana flour that was packaged in a transparent cellophane bag for further use.

Production of cake from flour blends of wheat and red banana

The method described by Ceserani & kinton (2008) was adopted and slightly modified for the production of cake. The ingredients used include: flour (400 g), butter (125 g), sugar (200 g), egg (300 g), milk (200 g), baking powder (0.5 g), vanilla essence (5 mL). Using an electric mixer (Model 28a-Bl England), sugar and butter were creamed until they become light and fluffy batter. The eggs were beaten for 5 mins with the homogenizer, liquid milk and vanilla essence were added to the homogenized egg and then poured into the fluffy batter and thoroughly mixed. Thereafter, a mixture of flour and baking powder were added to the batter, thoroughly mixed to uniform texture and then poured into greased cake pans. These were put in the oven and baked at temperature of 190°C for 15 min. After baking, the cakes were cooled to room temperature, removed from the pan after 1 h, packaged in low density polyethylene bags and sealed in an airtight transparent plastic container.

Formulation of Flour Blends

Table 1: Flour blends formulation (%)

Sample Code	Wheat	Red Banana
W0R0	100	0
W1R1	90	10
W2R2	80	20
W3R3	70	30
W4R4	60	40
W5R5	50	50
W6R6	40	60
W7R7	30	70
W8R8	20	80

Key:
W0R0 = 100% wheat flour (100:0, control sample)
W1R1 = 90% wheat flour: 10% Red banana flour (90:10)
W2R2 = 80% wheat flour: 20% Red banana flour (80:20)
W3R3 = 70% wheat flour: 30% Red banana flour (70:30)
W4R4 = 60% wheat flour: 40% Red banana flour (60:40)
W5R5 = 50% wheat flour: 50% Red banana flour (50:50)
W6R6 = 40% wheat flour: 60% Red banana flour (40:60)
W7R7 = 30% wheat flour: 70% Red banana flour (30:70)
W8R8 = 20% wheat flour: 80% Red banana flour (20:80)

Determination of functional properties of wheat and banana flour blends

Oil absorption capacity, water absorption capacity, bulk density, swelling index, gelatinization temperature and emulsion capacity were determined according to the method described by Onwuka (2018).

Determination of proximate composition of cakes produced from wheat-banana flour blends.

The moisture, ash, crude fibre, crude fat, protein and carbohydrate contents were determined by the methods described by Onwuka (2018), while the caloric value was determined using Atwater factor as described by Okaka *et al*. (2013).

Determination of physical properties of the cakes produced from wheat-banana flour blends.

The following physical properties (weight, height and volume) of the cakes were determined. The weight and volume were determined using the method described by Nwosu *et al.* (2014) while the height of the cakes were determined by measuring them with a calibrated ruler (Ayo *et al*., 2007).

Determination of sensory properties of the cakes produced from wheat-banana flour blends.

The method described by Iwe (2014) was adopted in the determination of sensory properties of the cake samples. The sensory properties of the cake samples were tested by 25 semi trained panelists of staff and students selected from the Department of Food Science and Technology, Michael Okpara University of Agriculture, Umudike. The panelists were instructed prior to the exercise. All cakes samples were put in different plates and served to the panelists with portable water to rinse their mouth after each testing so as not to interfere with the taste of the preceding samples. Sensory properties such as taste, appearance, aroma, texture and overall acceptability of the cakess was scored in a 9 point hedonic scale. The degree of likeness was expressed as follows from 9 = Like extremely, 5 = neither like nor dislike and 1 = dislike extremely.

Statistical Analysis

One way analysis of variance was carried out using the Statistical Product of Service Solution (SPSS) version 23.0. Treatment means were separated using Duncan multiple range test at 95% confidence level ($p<0.05$).

RESULTS AND DISCUSSION

Functional properties of wheat and red banana flour blends

The results of the functional properties of wheat and banana flour are blends are presented in Table 2. There were significant differences ($p<0.05$) in all the parameters evaluated for functional properties.

The oil absorption capacity (OAC) of the flour blends increased significantly ($p<0.05$) from 0.90-1.25g/ml for the control sample (W0R0, 100% wheat) and W8R8 (20% wheat flour: 80% Red banana flour) respectively. The result showed progressive increase in the OAC as the proportion of banana flour increased. This is in line with the report of Iwe *et al*. (2017) on cassava and wheat flour blends. Onwuka *et al*. (2015) also reported high OAC for two different banana varieties. Oil absorption capacity (OAC) is important because it acts as flavour retainer and increases the mouth feel of foods. The higher OAC obtained with increasing banana flour proportion in the blends is an indication that food sample containing higher levels of banana flour would have a better retention of flavour and would also give a better mouth feel.

The results of the water absorption capacity, bulk density, swelling index, gelatinization temperature and emulsion capacity followed the same trend with the oil absorption capacity, whereby these parameters had higher values than the control. It was observed that the values progressively increased with increased proportion of banana flour in all the parameters.

The water absorption capacity (WAC) significantly ($p<0.05$) increased from 0.08-1.50 g/ml for the control sample (W0R0, 100% wheat) and W8R8 (20% wheat flour: 80% Red banana flour) respectively. Higher values obtained with increase in the substitution of wheat flour with banana flour shows that banana flour has higher WAC than wheat flour. This can be attributed to the loose structure of starch polymers ((Twinomuhwezi *et al*., 2020) while low value indicates the compactness of the structure (Adebowale *et al.,* 2012). This can also be said to be due to lower moisture content which enhanced the hygroscopic property of the flour samples (Ubbor *et al*., 2021). Water absorption capacity is the capacity of flour to absorb water and swell for enhanced consistency in food. Samples with high water absorption capacity are indication that they have the capacity to absorb water and swell for enhanced consistency of the product.

There was a linear increase in the bulk density (0.78 g/cm^3 (W0R0, control sample (100% wheat flour) -8.33 g/cm^3 (W8R8)) of the flour blends as the proportion of banana flour increased. This is in line with the observation of Ayo-Omogie and Adekunle (2015) who reported increase in bulk density (0.76 – 0.82 g/cm^3) with increase in the substitution rate of wheat flour with banana flour in doughnut and cookies. Bulk density of the flours could be used to determine their handling requirement, because it is a function of mass to volume as well as the closeness of packaging (Okaka, 2009).
There was a significant difference in the swelling index of the flour blends. Values obtained were within the range of 1.58 g/ml (W0R0, control sample) – 2.82 g/ml (W8R8). The result showed that substitution of wheat with banana flour enhanced the swelling capacity of the flour blends. This is an indication that banana flour has the capacity to swell more than the control (100% wheat flour). Swelling capacity has been reported as part of the criteria for good quality products (Mensah *et al*., 2012).

The gelatinization temperature of the composite flour ranged from 61.50^{o}C (W0R0)–69.00^{o}C (W8R8). The values of gelatinization temperature obtained in this study is however, lower than results (56.50^{o}C-75.00^{o}C) obtained from a previous study form composite flour of wheat-acha and orange fleshed sweet potato (Ubbor *et al*., 2022). The value obtained increased linearly with increase in banana flour in the blends. Gelatinization temperature is the temperature at which the gelatinization of starch takes place (Iwe *et al*., 2016). The result of the gelatinization temperature followed the same trend with that of the other parameters determined in the functional properties. The gelatinization temperature increased with increase in the proportion of banana flour (Table 2). The highest gelatinization temperature (69.00°C) obtained in the flour blends (sample W8R8) could probably be as a result of its high carbohydrate content (Table 3). This could also be attributed to the fact that its starch granules were more damaged thus facilitating swelling (Awuchi *et al*., 2019). The lowest value of gelatinization temperature obtained in flour produced from the control (W0R0, 100% wheat) could probably be due to its protein and fat content (Table 3).
The emulsion capacity of the flour blends increased significantly ($p<0.05$) from 38.10 to 48.76% as the substitution rate of wheat flour with banana flour increased. The control sample (W0R0, 100% wheat flour) had the lowest value (38.10%) while sample W8R8 (20% wheat flour: 80% Red banana flour) had the highest value (48.76%). Similar observation (36.23-57.91%) was reported by Iwe *et al*. (2017) for wheat - cassava flour blends. Ayo-Omogie & Adekunle (2015) also gave similar submission in their research on substitution of wheat flour with banana flour for the production of doughnut and cookies. Samples with high emulsion capacities as observed in this research are positive indication that the flour samples could have excellent emulsifying properties in various foods (Mensah *et al*., 2012).

Proximate composition of cakes produced from wheat and banana flour blends
The proximate composition of the wheat/banana cakes are presented in Table 3. There were significant differences ($p<0.05$) in the results of the proximate composition of the cake samples evaluated.

The result showed that the moisture content of the cakes ranged from 9.20 to 11.80% for samples W8R8 (20% wheat flour: 80% red banana flour) and W0R0 (100% wheat flour) respectively. The moisture content of the cake samples decreased with increased proportion of banana flour. This is evidence that cake samples with high proportion of banana flour would have longer shelf life stability since they have lower moisture contents. High moisture content in food samples is of great disadvantage as it encourages microbial activities that lead to food spoilage (Anno *et al*., 2016). Previous researchers opined that baked products with moisture content less than 13% are stable from moisture-dependent deterioration (Ayo-Omogie & Odekunle, 2015). The moisture content of all the cakes produced was below this specified moisture content indicating that they can be stored at room temperature and be less prone to fungal and microorganism infections (Awuchi, 2019).

Table 2: Functional properties of wheat/banana flour blends

SAMPLE	OAC (g/ml)	WAC (g/ml)	BD (g/cm^3)	SI(g/ml)	GET (^0C)	EC (%)
W0R0	$0.90^{i}\pm0.00$	$0.80^{f}\pm0.00$	$0.78^{f}\pm0.00$	$1.58^{i}\pm0.01$	$61.50^{h}\pm0.71$	$38.10^{i}\pm0.00$
W1R1	$0.94^{h}\pm0.01$	$1.00^{e}\pm0.14$	$0.79^{e}\pm0.03$	$1.69^{h}\pm0.00$	$62.00^{h}\pm0.00$	$39.25^{h}\pm0.14$
W2R2	$0.98^{g}\pm00.01$	$1.10^{de}\pm0.00$	$0.80^{d}\pm0.00$	$1.83^{g}\pm0.01$	$63.00^{g}\pm0.00$	$41.08^{g}\pm0.08$
W3R3	$1.02^{f}\pm0.01$	$1.15^{d}\pm0.01$	$0.80^{d}\pm0.01$	$2.00^{f}\pm0.00$	$64.00^{f}\pm0.00$	$41.87^{f}\pm0.16$
W4R4	$1.06^{e}\pm00.01$	$1.20^{cd}\pm0.00$	$0.81^{c}\pm0.01$	$2.19^{e}\pm0.03$	$65.00^{e}\pm0.00$	$43.22^{e}\pm0.00$
W5R5	$1.10^{d}\pm0.00$	$1.30^{bc}\pm0.07$	$0.82^{b}\pm0.00$	$2.30^{d}\pm0.01$	$66.00^{d}\pm0.00$	$45.17^{d}\pm0.14$
W6R6	$1.15^{c}\pm0.00$	$1.40^{ab}\pm0.00$	$0.82^{b}\pm0.03$	$2.51^{c}\pm0.01$	$67.00^{c}\pm0.00$	$46.28^{c}\pm0.06$
W7R7	$1.20^{b}\pm0.00$	$1.45^{a}\pm0.00$	$0.83^{a}\pm0.01$	$2.69^{b}\pm0.03$	$68.00^{b}\pm0.00$	$47.35^{b}\pm0.00$
W8R8	$1.25^{a}\pm0.01$	$1.50^{a}\pm0.00$	$0.83^{a}\pm0.01$	$2.82^{a}\pm0.00$	$69.00^{a}\pm0.00$	$48.76^{a}\pm0.07$

a-i: Means ± standard deviation of duplicate determination. Means bearing the same superscripts within the same column are not significantly different (p>0.05)
OAC = Oil absorption capacity, WAC= Water absorption capacity, BD= Bulk density, SI= Swelling index, GT= GET= gelatinization temperature, EC= emulsion capacity

Key:
W0R0 = 100% wheat flour (100:0)
W1R1 = 90% wheat flour: 10% red banana flour (90:10)
W2R2 = 80% wheat flour: 20% red banana flour (80:20)
W3R3 = 70% wheat flour: 30% red banana flour (70:30)
W4R4 = 60% wheat flour: 40% red banana flour (60:40)
W5R5 = 50% wheat flour: 50% red banana flour (50:50)
W6R6 = 40% wheat flour: 60% red banana flour (40:60)
W7R7 = 30% wheat flour: 70% red banana flour (30:70)
W8R8 = 20% wheat flour: 80% red banana flour (20:80)

There was a significant (p<0.05) increase in the ash content of the cake samples from 1.20-2.25% for the control samples W0R0 (100% wheat flour) and 20% wheat flour: 80% red banana flour respectively. The result showed that banana flour enhanced the ash content of the cakes. Similar observation was reported by Ayo-Omogie & Adekunle (2015) for doughnut and cookies produced from wheat and banana flours. Iwe *et al*. (2016) affirmed that the ash content of food gives an idea of the total quantity of the mineral elements in the food. Based on this fact, high ash content as observed in cake samples with high proportions of banana flour would possess high mineral content than the control sample (100% wheat). This implies that such samples would serve as good sources of mineral.

The fat content of the samples significantly (p<0.05) increased from 18.60 to 21.45% for cake samples W8R8 (20% wheat flour: 80% red banana flour) and the control sample (W0R0, 100% wheat) respectively. This could be attributed to the fact that bananas are not good sources of fat. They study proved that wheat has higher fat content than banana. Fat content of the samples decreased as the proportion of banana flour increased. Similar observation was reported by Etong *et al*. (2014) and Ayo-Omogie & Adekunle (2015).

There was a significant increase (p<0.05) in the fibre content (1.70 to 3.70%) of the cakes as the level of substitution of wheat flour with banana flour increased. This is an indication that banana contains high fibre than wheat from the result of this study. This is in line with the report of Etong *et al*. (2014) who obtained higher value for plantain flour (4.19%) compared to wheat flour (0.75%) and the report of Kiin-Kabari *et al*. (2017) for increased fibre content of wheat flour cookies fortified with moringa leaf power. According to Lisa (2007), fibre has the ability of cleansing digestive tract by removing potential carcinogens from the body and preventing the absorption of excessive cholesterol.

The protein content of the cakes ranged from 4.00 to 11.05% for cake samples W8R8 (20% wheat: 80% red banana flour) and control (W0R0, 100% wheat). A progressive reduction in the protein values of the cakes was observed as the proportion of banana flour increased. This suggests that banana contains lower protein compared than wheat. Ayo-Omogie & Adekunle (2015) also reported a decrease in the protein content of doughnut and cookies as the substitution rate of wheat with banana increased. Proteins are important food components, necessary for growth and repair of damaged tissues (Wardlaw, 2004).

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The carbohydrate content of the cakes increased from 53.95-62.35% for the control cake sample and W8R8 (20% wheat flour: 80% red banana flour) respectively. The result showed progressive increase in the carbohydrate content as the level of substitution of banana flour increased. This suggests that banana flours are rich sources of carbohydrate as compared to wheat. The result has shown that the cake samples with banana flour are rich in carbohydrate, thus will serve as a source of energy to its consumers. Previous researchers obtained a similar result of carbohydrate contents of cookies made flour blends of cardaba banana being higher than cookies from 100% wheat flour (Ayo-Omogie & Adekunle (2015). Ubbor *et al*. (2022) also reported a similar result of increase in carbohydrate content of cookies as the proportion of acha and orange fleshed sweet potato increased.

The energy value of the cake samples significantly ($p<0.05$) increased from 432.80-453.05 Kcal/100g for cake sample W8R8 (20% wheat flour: 80% red banana flour) and control sample (W0R0, 100% wheat) respectively. The increase in the energy value could be attributed to the significant fat and protein contents of the control cake sample (Table 3). Lower values (339 – 359Kcal/100g) was reported by Kiin-Kabari *et al*. (2015), but compared to the range 403 – 460 Kcal/100g reported by Eke *et al.* (2008) for Nigerian cakes sold in Port Harcourt. These differences may be due to recipe formulation and methods of preparation.

Table 3: Proximate composition (%) and energy value (Kcal/100g) of cake produced from wheat/banana composite flour

Sample Codes	Moisture	Ash	Fat	Fibre	Protein	Carbohydrate	Energy (Kcal/100g)
W0R0	$11.80^{a}\pm0.00$	$1.20^{h}\pm0.0$	$21.45^{a}\pm0.07$	$0.55^{i}\pm0.07$	$11.05^{a}\pm0.07$	$53.95^{i}\pm0.35$	$453.05^{a}\pm0.49$
W1R1	$11.40^{b}\pm0.14$	$1.25^{gh}\pm0.07$	$21.05^{b}\pm0.07$	$0.80^{h}\pm0.00$	$10.20^{b}\pm0.14$	$55.30^{h}\pm0.00$	$451.45^{b}\pm1.20$
W2R2	$11.00^{c}\pm0.00$	$1.35^{g}\pm0.07$	$20.70^{c}\pm0.14$	$1.20^{g}\pm0.141$	$9.45^{c}\pm0.07$	$56.30^{g}\pm0.28$	$449.30^{c}\pm0.42$
W3R3	$10.80^{cd}\pm0.14$	$1.45^{f}\pm0.07$	$20.30^{d}\pm0.00$	$1.55^{f}\pm0.07$	$8.50^{d}\pm0.00$	$57.40^{f}\pm0.00$	$446.60^{d}\pm0.00$
W4R4	$10.60^{d}\pm0.00$	$1.60^{e}\pm0.00$	$20.00^{e}\pm0.00$	$2.00^{e}\pm0.14$	$7.30^{e}\pm0.14$	$58.50^{e}\pm0.28$	$443.20^{e}\pm0.56$
W5R5	$10.20^{e}\pm0.00$	$1.75^{d}\pm0.07$	$19.70^{f}\pm0.00$	$2.40^{d}\pm0.00$	$6.70^{f}\pm0.14$	$59.25^{d}\pm0.35$	$441.10^{f}\pm0.42$
W6R6	$9.80^{f}\pm0.00$	$1.90^{c}\pm0.00$	$19.40^{g}\pm0.14$	$2.90^{c}\pm0.14$	$5.70^{g}\pm0.00$	$60.30^{c}\pm0.38$	$438.60^{g}\pm0.14$
W7R7	$9.60^{f}\pm0.14$	$2.05^{b}\pm0.07$	$19.05^{h}\pm0.00$	$3.30^{b}\pm0.00$	$5.15^{h}\pm0.00$	$60.85^{b}\pm0.07$	$435.45^{h}\pm0.85$
W8R8	$9.20^{g}\pm0.00$	$2.25^{a}\pm0.07$	$18.60^{i}\pm0.07$	$3.60^{a}\pm0.14$	$4.00^{i}\pm0.00$	$62.35^{a}\pm0.14$	$432.80^{i}\pm0.07$

a-i: Means ± standard deviation of duplicate determination. Means bearing the same superscripts within the same column are not significantly different ($p>0.05$).

Key:
W0R0 = 100% wheat flour (100:0)
W1R1 = 90% wheat flour: 10% red banana flour (90:10)
W2R2 = 80% wheat flour: 20% red banana flour (80:20)
W3R3 = 70% wheat flour: 30% red banana flour (70:30)
W4R4 = 60% wheat flour: 40% red banana flour (60:40)
W5R5 = 50% wheat flour: 50% red banana flour (50:50)
W6R6 = 40% wheat flour: 60% red banana flour (40:60)
W7R7 = 30% wheat flour: 70% red banana flour (30:70)
W8R8 = 20% wheat flour: 80% red banana flour (20:80)

Physical properties of cakes produced from wheat and banana flour blends

The results for the physical properties of the cake samples are presented in Table 4. Significant differences ($p<0.05$) existed amongst the cake samples in terms of physical properties.

The weight of the cake samples ranged from 83.10 to 84.91g for the control cake sample (W0R0, 100% wheat flour) and W7R7(30% wheat flour: 70% red banana flour), respectively. Cakes produced from all the flour blends had higher weights than the control (83.10g). This could be attributed to the high carbohydrate content of the cakes samples compared to the control sample. It could also be attributed to the increasing bulk density obtained with increasing banana proportion in the samples. Increase in bulk density enables the flour to be more compressed when stacked, thus, causing an increase in the weight of the product. However, the weights of the cakes were higher than values (25.73-26.59g) obtained from previous researchers for cake produced from wheat/bambara groundnut flours (Adegbanke & Ayomiposi, 2019).

The height of the cakes ranged from 3.10cm to 3.55cm for samples W8R8 (20% wheat flour: 80% red banana flour) and W0R0 (100% wheat flour, control). Gradual decrease in height of the cakes was observed with increase in the proportion of banana flour. This could be due to the fact that wheat contains high level of gluten that causes the rising of dough in the presence of heat. Similar observation was reported by Emmanuel *et al*. (2012) for cake made from flour blends of wheat and beniseed.

The cake volume decreased from 291.50 cm^3 to 214.50cm^3as the rate of substitution of wheat with banana in the samples increased. The least value of the cake volume (214.50cm^3) was recorded for sample W8R8 (20% wheat flour: 80% red banana flour), while the control had the highest value (291.50 cm^3). This is not surprising since wheat flour has high gluten content, and tends to rise better than banana flour. Emmanuel *et al*. (2012) reported similar observation for cake made from flour blends of wheat and beniseed. Kiin-Kabari & Banigo (2015) also reported decrease in volume as the rate of substitution of wheat with plantain flour increased.

Table 4: Physical properties of cake produced from wheat/banana flour blends

Sample code	Weight (g)	Height (cm)	Volume (cm^3)
W0R0	$83.10^{f}\pm0.03$	$3.55^{a}\pm0.00$	$291.50^{a}\pm2.12$
W1R1	$83.37^{ef}\pm0.06$	$3.50^{ab}\pm0.00$	$282.50^{b}\pm3.54$
W2R2	$83.68^{de}\pm0.04$	$3.40^{abc}\pm0.14$	$272.00^{c}\pm2.83$
W3R3	$83.97^{cd}\pm0.10$	$3.40^{abc}\pm0.07$	$267.00^{c}\pm2.83$
W4R4	$84.22^{bc}\pm0.25$	$3.35^{bcd}\pm0.07$	$250.00^{d}\pm1.41$
W5R5	$84.50^{ab}\pm0.07$	$3.30^{cd}\pm0.00$	$242.00^{e}\pm1.41$
W6R6	$84.74^{ab}\pm0.04$	$3.25^{cd}\pm0.00$	$234.00^{f}\pm1.49$
W7R7	$84.91^{a}\pm0.07$	$3.20^{de}\pm0.00$	$227.00^{g}\pm2.83$
W8R8	$84.78^{a}\pm0.06$	$3.10^{e}\pm0.00$	$214.50^{h}\pm3.54$

a-h: Means ± standard deviation of duplicate determination. Means bearing the same superscripts within the same column are not significantly different (p>0.05).

Key:
W0R0 = 100% wheat flour (100:0)
W1R1 = 90% wheat flour: 10% red banana flour (90:10)
W2R2 = 80% wheat flour: 20% red banana flour (80:20)
W3R3 = 70% wheat flour: 30% red banana flour (70:30)
W4R4 = 60% wheat flour: 40% red banana flour (60:40)
W5R5 = 50% wheat flour: 50% red banana flour (50:50)
W6R6 = 40% wheat flour: 60% red banana flour (40:60)
W7R7 = 30% wheat flour: 70% red banana flour (30:70)
W8R8 = 20% wheat flour: 80% red banana flour (20:80)

Sensory Evaluation

The sensory properties of the cake samples are presented in Table 5. There was significant differences (P<0.05) amongst the sensory properties of the cakes produced. The result showed that the scores obtained in all the parameters decreased with increase in the proportion of banana flour in the samples. The scores for taste of the cake samples ranged from 4.35-7.30 for cake sample W8R8 (20% wheat flour: 80% red banana flour) and control (W0R0, 100% wheat flour). In terms of appearance, aroma, texture and general acceptability, the control sample(100% wheat was preferred and followed strictly by cake samples produced from up to 30% banana flour. Thus, this showed that the panelists had similar preference for the control and the cake containing 10%, 20% and 30% banana flour. This is an indication that substitution of banana flour up to 30% would give good quality acceptable products compared to 100% wheat. Similar finding was reported by Ayo-Omogie & Adekunle (2015) on doughtnut and cookies made from wheat and plantain flour.

Table 5: Sensory properties of cake produced from wheat and banana composite flour

S/N	Taste	Appearance	Aroma	Texture	General Acceptability
W0R0	$7.30^{a}\pm1.22$	$7.15^{a}\pm1.18$	$7.40^{a}\pm1.27$	$7.10^{a}\pm1.25$	$7.20^{a}\pm1.32$
W1R1	$6.90^{ab}\pm1.07$	$6.80^{ab}\pm1.15$	$7.25^{ab}\pm1.12$	$6.85^{ab}\pm1.04$	$7.00^{ab}\pm1.08$
W2R2	$6.80^{ab}\pm2.09$	$6.55^{ab}\pm2.26$	$7.10^{ab}\pm1.21$	$6.60^{b}\pm2.30$	$6.85^{ab}\pm1.90$
W3R3	$6.55^{ab}\pm1.04$	$6.35^{ab}\pm2.25$	$6.80^{b}\pm1.21$	$6.20^{bc}\pm1.99$	$6.35^{b}\pm2.11$
W4R4	$6.25^{b}\pm2.24$	$5.90^{b}\pm2.34$	$6.40^{bc}\pm2.21$	$5.75^{c}\pm2.53$	$5.90^{bc}\pm2.51$
W5R5	$5.70^{c}\pm2.56$	$5.60^{bc}\pm1.90$	$6.05^{c}\pm1.79$	$5.55^{c}\pm2.21$	$5.55^{c}\pm2.82$
W6R6	$5.00^{cd}\pm2.82$	$5.35^{bc}\pm2.30$	$5.75^{cd}\pm2.67$	$5.20^{cd}\pm2.09$	$5.15^{cd}\pm2.96$
W7R7	$4.65^{d}\pm2.18$	$4.90^{c}\pm2.31$	$5.45^{d}\pm2.01$	$4.85^{de}\pm2.39$	$4.35^{d}\pm2.49$
W8R8	$4.35^{d}\pm2.81$	$4.65^{c}\pm2.37$	$5.00^{e}\pm1.90$	$4.60^{e}\pm2.41$	$4.35^{d}\pm2.49$

a-e: Means ± standard deviation of duplicate determination. Means bearing the same superscripts within the same column are not significantly different (p>0.05).

Key:
W0R0 = 100% wheat flour (100:0)
W1R1 = 90% wheat flour: 10% red banana flour (90:10)
W2R2 = 80% wheat flour: 20% red banana flour (80:20)
W3R3 = 70% wheat flour: 30% red banana flour (70:30)
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W5R5 = 50% wheat flour: 50% red banana flour (50:50)
W6R6 = 40% wheat flour: 60% red banana flour (40:60)
W7R7 = 30% wheat flour: 70% red banana flour (30:70)
W8R8 = 20% wheat flour: 80% red banana flour (20:80)

Conclusion

This study has shown that acceptable cake could be produced with flour blends of wheat and red banana. This present study revealed that proportion of banana flour in the wheat composite enhanced all the parameters investigated for the functional properties. Ash, fiber, carbohydrate, and weight of the cake samples were also enhanced. However, there was a corresponding decrease in the protein, fat and caloric value, in cake samples with increased levels of banana flour. Reduction in fat content and caloric value in cakes with increased proportion of banana flours could be seen as good functional products for healthy eating, while increased crude fibre and ash is an indication of possible increase in dietary fibre and presence of minerals in the cakes respectively, All these nutritional qualities makes banana flour a functional food ingredient and hence a good substitute for wheat. Cake samples containing up to 30% banana flour were generally accepted and compared favourably with the control sample (100% wheat) in all the parameters analyzed. This implies that up to 30% inclusion of banana flour is acceptable for the production of cake a nutritious cake.

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