Efficiency of wheat: maize composite flour as affected by baking method in bread and cake production

Onuegbu N. C.*, Ihediohanma N.C., Odunze O. F and Ojukwu M.

Department of Food Science and Technology, Federal University of Technology Owerri

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Bread and cake samples were produced from wheat (Triticum aestivum) and maize (Zea mays) composite flour using different methods of production. The wheat : maize composite ratios were 100:0, 95:5, 90:20, 85:15 and 80:20. The results of the functional analysis show that the 80 : 20 wheat : maize composite had the highest values for bulk density (0.95 g/cm³), swelling index(1.96 g), water absorption capacity 2.52 g/g and oil absorption capacity 2.66 g/g. The 80: 20 composite flour had the lowest protein content of 9.95% while 100% wheat flour had highest value of 10.74%. The sensory results showed that bread baked with 95: 5, 90:10 and 85:15 wheat : maize flour were not significantly different (at P > 0.05) from the 100% wheat flour bread sample in most attributes. The no-time method gave best results in most quality attributes. The results for cake showed that cake baked with 5, 10, 15 and 20% maize had no significant difference (P < 0.05) with the 100% wheat flour in all quality attributes and creaming method gave best result. Therefore, wheat substitution with up to 15 and 20% maize flour will respectively yield bread and cake of desirable characteristics while no-time and creaming method for bread and cake respectively are the best methods for use when wheat : maize flour is used.

Key words: Bread, cake, composite flour, maize, wheat.

INTRODUCTION

Bread is a staple food product prepared by baking dough of flour and water (Osuji, 2008). It has high nutritional value and its consumption is steadily on the increase in Nigeria due to its convenience as a ready to eat food product (David, 2006). Wheat flour is particularly well suited for bread making because of its glutenin and gliadin content. These two substances combine with water to form the gluten network which is essential for dough development during bread making (Dwyer and O'Halloran, 1991). However wheat is not grown in Nigeria and the nation embarks on massive wheat importation annually in order to satisfy the demand for wheat. As a result the use of composite flours has become a useful alternative. To encourage the use of composite flours the Federal Government of Nigeria has ordered a 10% substitution on all wheat flours with high quality cassava flour. Since then several attempts have been made to substitute wheat flour with flours from other cereals as well as tubers and roots (Oyanekua and Adeleye, 2009; FAO 2006; Oluwole et al., 2006; Idowu et al., 1996).

In the case of cake making, production does not require high gluten flour however using a composite flour in commercial cake production will help to reduce wheat importation which is of major concern to the government. It is therefore necessary to determine how composite flours perform using different baking methods for bread and cake since it has been reported that baking method contributes to the final characteristics of the baked product (Potter and Hotchkiss, 1995). However, no work has been focused on determining the specific effects of the different baking methods on the results obtained from the composite flours.
This work was therefore aimed at investigating the effects of different bread-making methods on the bread and cake produced with different levels of wheat : maize composite flours. The result obtain will provide information that will enable bakers decide on the most appropriate baking method to use.

**METHODOLOGY**

**Procurement and preparation of materials**

The wheat flour, maize grains and other baking ingredients were purchased from Eke-ukwu Owerri main market. The equipment used were from the department of Food Science and Technology, Federal University of Technology, Owerri, Nigeria, where the work was carried out. The maize grains were sort, cleaned properly sun dried before milling with a locally fabricated attrition mill. The flour obtained was sieved through aperture size 425 µm sieves to obtain fine flour. The composite flours were then prepared using different wheat/maize ratios. (100:0, 95:5, 90:10, 85:15, 80:20).

**Functional properties of flours**

**Bulk density (Bd)**

A 50 g flour sample was put into a 100 ml measuring cylinder. The cylinder was tapped continuously on a laboratory bench until a constant volume was obtained. The bulk density (g/cm3) was calculated as weight of flour (g) divided by flour volume (cm³) (Okaka and Potter, 1977).

**Water and oil absorption capacities**

Water and oil absorption capacities of the flour samples were determined by Beuchat (1977) method. 1 g of the flour was mixed with 10 ml of water or refined oil in a pre-weighed 20 ml centrifuge tube. The slurry was agitated for 2 mins, allowed to stand at 28°C for 30 min and then centrifuged at 500 rpm for 20 min. The volume of free water or oil (the supernatant) was read directly from the graduated centrifuge tube. The weight of water absorbed by 1 g of flour was calculated and expressed as water absorption capacity while the weight of oil absorbed by 1 g of flour was expressed as oil absorption capacity.

**Wettability**

1 g of flour sample was added into a 25 ml graduated cylinder with a diameter of 1 cm. A finger was placed over the open end of a cylinder, it was inverted and clamped at a height of 10 cm from the surface of a 600 ml beaker containing 500 ml of distilled water. The finger was then removed to allow the test material to be dumped. The wettability is the time required for the sample to become completely wet (Onwuka, 2005).

**Swelling index**

1 g of each flour sample was transferred into a clean dry graduated cylinder. The flour samples were gently levelled and the volume noted. Distilled water was added to each sample at different ratios to make up to 10 ml. The cylinder was swirled and allowed to stand for 60 mins, while change in volume (swelling) was recorded every 15 min, the swelling power of each flour sample was calculated as a multiple of the original volume as done by Ukpai and Ndimele (1990).

**Proximate analysis on flour samples**

The procedures for the proximate analysis were as outlined in the Association of Official Analytical Chemist (A.O.A.C., 1990) as described below.

**Ash content determination**

5 g each of the flour were weighed and placed into crucibles which have been cleaned and weighed. The samples were dried, ignited and cooled in a dessicator and re-weighed. They were then charred over a hot plate until no more soot was given off.

The dish and the content were transferred using a pair of tongs into a muffle furnace at 400°C and increased gradually to 550°C. It was incinerated until light grey ash was obtained. The ash was calculated on percentage basis:

\[
\text{% Ash} = \frac{\text{Weight of ash}}{\text{weight of sample}} \times 100
\]

**Moisture content determination**

The aluminium dishes were weighed initially using a weighing balance (AOAC 1990), then 5 g of the flours were weighed into the aluminium dishes. A spatula was used for sample transfer and spreading across the bottom of the drying pan. The dishes containing the samples were placed in the oven. The samples were dried at a temperature of 105°C until a constant weight is obtained. After this, they were removed and placed in the dessicator to cool for about 30 min.

The moisture content was calculated as the difference in weight of samples, before and after drying, on percentage basis:

\[
\text{% moisture} = \frac{\text{loss in weight of sample}}{\text{Original weight of sample}} \times 100
\]

**Crude protein determination**

This was determined using the standard Kjeldahl method.
% Protein = \frac{0.00014 \times (T - B) \times N \times V_t \times 100 \times 6.25}{W}

T = \text{Titre value for sample}
B = \text{Titre value for blank}
N = \text{Normality of HCl}
V_t = \text{Total digest volume}
V_a = \text{Volume of aliquot}
W = \text{Weight of sample}

**Crude fat determination**

250 ml soxhlet flask was washed and dried in the oven at the temperature of 105°C for 3 min. The flask was cooled in the dessicator and weighed. Then, 5 g of the flour samples were weighed into a filter paper and wrapped properly. It was then carefully transferred into the thimble and the thimble was placed into the extracting unit. The weighing dish was rinsed with a solvent and poured into the thimble and was plugged with defatted cotton wool. The cleaned soxhlet flask containing anti-bumping granules was added the solvent to fill about two-thirds of the volume of the flask and fitted with the soxhlet extraction unit. Then, the fat were extracted from the samples continuously for about 3 – 5 h with the solvent condensing at 5 - 6 drops in the soxhlet extraction unit. When extraction was complete, petroleum ether was distilled from the flask using a thermo-regulated hot water bath. When the petroleum ether vapour has been completely removed, the flask was dried in the oven at 100°C for 5 mins, after which the flask was cooled in a dessicator and weighed. The difference in weight was calculated as crude fat content on percentage basis.

% Fat = \frac{\text{Weight of extracted fat} \times 100}{\text{Weight of sample}}

**Total dietary fibre content**

One gram of sample was weighed into a 50 ml centrifuge tube, 2 ml dimethyl sulphoxide was added and capped. The mixture was stirred for about 2 mins on a magnetic stirrer to homogenize it and the tube placed in a beaker of boiling water on a hot plate with stirring. It was then allowed to mix for 1 h after which the tube was removed, without cooling, 8 ml of sodium acetate buffer at pH 5.2 will be added, pre-equilibrated at 50°C and vortex mixed. The tube was left at room temperature at about 35°C until the content cooled to between 30°C and 40°C. 0.5 ml of alpha-amylase solution followed by 0.1 ml of pullulanase solution will be added and vortex mixed. The tube was capped and incubated overnight with continuous mixing for the first 1 h. 40 ml of ethanol was added mixed well by inversion and left for 1 h at room temperature. The mixture was then centrifuged at 1500 g for 10 min and then removed as much as possible of the supernatant by decantation without disturbing the residue. The residue was then washed twice using 50 ml 85% ethanol each time and mixed by inversion and left for 1 h at room temperature. The mixture was then centrifuged at 1500 g for 10 min. The supernatant liquid was removed by discarding and placing tube in a beaker of water at 650°C - 750°C on a stirrer hot plate with continuous stirring of the content to mix till the residue appeared totally dry (Englyst, 1997).

% total dietary fibre is calculated using the formula:

\text{Weight of residue/weight of sample} \times 100

**Carbohydrate content**

The carbohydrate content of the flours was estimated according to AOAC (1990):

% carbohydrate = 100 – (% fat + % protein + % ash + % dietary fibre + % moisture).

**Production of bread (McWilliam, 1985; Stauffer, 1990)**

Five sample flours were used for the bread production based on the various wheat : maize ratios(100:0,95:5, 90:10, 85:15, 80:20) (Table 1).

**Sponge and dough method**

Loaves were prepared using sponge and dough method. The first stage of production involved mixing of half of the flour sample, all the yeast and 150 ml of water for 5 min in a mixing bowl. The mixture was allowed to ferment at room temperature for 9 h to form the “sponge”. The
second stage involved addition of all the other ingredients (salt, sugar and the remaining flour) into the sponge and it was mixed thoroughly for 5 minutes. The dough formed was kneaded, moulded into cylindrical shape on a working table, placed in a clean grease pan and allowed to proof at room temperature for 45 min. The well proofed dough was baked in a preheated cabinet oven at 240°C and baked for 15 min. After baking the pans were withdrawn from the oven, de-panned by knocking-out manually and allowed to cool at room temperature for 60 min before packaging.

**Straight dough method**

Loaves were prepared using the straight dough method. All the ingredients were added to the flour sample and dry mixed properly for 5 min using hands in a mixing bowl. After which 100 ml of water was added and mixed for another 10 min by hand to form dough. The dough formed was kneaded for 5 min on a greased working table and then placed back into the bowl, covered with damp cotton cloth and allowed to proof until double its original size at room temperature for about 2 h (intermediate proofing). After which it was knocked-back on a working table using hand, then moulded into cylindrical shape and placed in a clean grease pan where it was allowed to proof the second time for 45 min at room temperature. The well proofed dough was baked in a preheated cabinet oven at 240°C for 15 min. After baking the pan was withdrawn from the oven, de-panned by knocking-out manually and the bread allowed to cool at room temperature for 60 min before packaging.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantity(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour(wheat or Composite)</td>
<td>100</td>
</tr>
<tr>
<td>Sugar</td>
<td>10</td>
</tr>
<tr>
<td>Fat</td>
<td>5</td>
</tr>
<tr>
<td>Yeast</td>
<td>0.9</td>
</tr>
<tr>
<td>Salt</td>
<td>0.5</td>
</tr>
</tbody>
</table>

**Table 1.** The recipe used for bread production by percentage.

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Quantity(g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour(wheat or Composite)</td>
<td>100</td>
</tr>
<tr>
<td>Fat</td>
<td>50</td>
</tr>
<tr>
<td>Sugar</td>
<td>43</td>
</tr>
<tr>
<td>Baking powder</td>
<td>2</td>
</tr>
<tr>
<td>Salt</td>
<td>0.5</td>
</tr>
<tr>
<td>Eggs</td>
<td>2 eggs</td>
</tr>
</tbody>
</table>

**Table 2.** The recipe used for cake production by percentage.

**Sourdough method**

Loaves were prepared using sourdough method. The sponge or ferment was prepared as described in sponge and dough method above using 100 ml water and allowed to ferment for 28 h. After which all the other ingredients were added to the “ferment” and mixed thoroughly for 5 min in the mixing bowl using hand. The dough formed is kneaded on a greased table for 5 mins, moulded into cylindrical shape and placed in a greased pan where it is allowed to proof for 45 min at room temperature. After proofing, the dough was baked in a preheated cabinet oven at 240°C for 15 min. The baked loaf was then de-panned by knocking-out and allowed to cool at room temperature for 60 min before packaging.

**No-time dough method**

All the ingredients were added to the flour sample and mixed thoroughly for 5 min before the addition of 100 ml water. The mixing lasted for 10 min and this was done using hand. After mixing, dough was formed. The dough formed was kneaded on a greased working table for 5 mins with maximum energy input, then moulded into cylindrical shape and placed inside a grease pan where it is allowed to proof for 2 h at room temperature. The well proofed dough was baked in a preheated cabinet oven at 240°C for 15 min. After baking, the bread sample was withdrawn from the oven, de-panned by knocking-out manually and allowed to cool at room temperature for 60 min.

**Cake production (McWilliam, 1985; Stauffer, 1990)**

Five sample flours were used for the bread production based on the various wheat : maize ratios(100:0, 95:5, 90:10, 85:15, 80:20) (Table 2).

**Creaming method**

All the fat and sugar were poured into a mixing bowl and creamed using a wooden hand mixer in a clockwise direction until fluffy and sugar well dissolved. The egg was broken open and its content whipped for 2 mins using a manual whipper in a clean plastic plate. The beaten egg and flour sifted with baking powder were added alternatively into the creamed mixture with constant slow stirring still in the same direction (clockwise direction). This is done until proper absorption of flour and a smooth batter formed. The batter is then poured into a greased cake pan and then baked at 180°C for 20 min in preheated cabinet oven. After baking it is withdrawn from the oven, de-panned by knocking-out and allowed to cool at room temperature for 1 h before packaging.
Whisking method

The eggs were broken open into a mixing bowl using a stainless steel fork followed by addition of sugar. The mixture was whipped thoroughly using a manual whipper until totally foamy and thick for 10 mins. After which the flour was lightly folded in until completely absorbed or wet. The batter formed is then poured into a greased pan, baked in a preheated cabinet oven at 180°C for 20 min, de-panned by knocking out and allowed to cool at room temperature for 1hr before packaging.

Rubbing – in method

The flour and other dry ingredients were mixed with the fat for 10 mins in a mixing bowl using the finger tips until it appeared like bread crumbs. This was followed by the addition of sugar with mixing for another 5mins. The egg was broken open and its content whipped for 2 mins using a manual egg whipper in a separate plate. The beaten egg was added to the mixture and stirred in lightly as in the case of creaming method. The batter formed was poured into a greased cake pan, baked in a preheated oven at 180°C for 20 mins, de-panned by knocking-out manually and allowed to cool at room temperature for 1 h before packaging.

Melting method

All the fat and sugar were poured into a stainless-steel plate and placed in the hot cabinet oven for 10 min to melt. The mixture was withdrawn from the oven, allowed to cool for 3 mins. It was then transferred into a mixing bowl where the beaten egg and flour already mixed with baking powder were added. The mixing was done slowly until a smooth batter is obtained. The batter formed was poured into a greased cake pan, baked in a preheated cabinet oven at 180°C for 20 mins, de-panned by knocking-out manually and allowed to cool at room temperature for 1 h before packaging.

Evaluation of bread and cake quality

Sensory evaluation of bread and cake samples

Evaluation of properties (crust colour, crumb colour, texture, taste, aroma and overall acceptability) of the bread and cake samples were done by the method of described by Onwuka (2005).

Bread and cake samples for the panelists evaluation were coded and presented to the 20 member panel drawn from students of Food Science and Technology Department, Federal University of Technology Owerri, Nigeria. The panelists were requested to analyse the samples based on the properties above. A nine point hedonic scale ranging from 9 (like extremely) to 1 (dislike extremely) was used in the evaluation of the bread and cake quality.

Volume and weight measurement of bread and cake samples

Volume was measured using soybean seeds displacement method (Matz, 1991). A box of 300 ml was filled with soybean grains. The grains were then poured out and used in refilling the box containing the bread or cake sample. The final level of the grain minus the initial level obtained was taken. The volume of displaced grain is equal to the volume of the bread or cake sample. The weight of bread and cake was measured using weighing balance.

Specific volume

Specific volume was obtained by dividing the loaf volume of bread/cake by its corresponding loaf weight (Horsfall et al., 2007). Thus, Specific volume = v / wt (cm^3/g).

Statistical analysis

The results obtained from functional properties analysis, proximate analysis of the flour samples, sensory evaluation, volume of bread and cake samples, weight of bread and cake samples as well as specific volume were statistically analysed manually using the analysis of variance (ANOVA) while the means were separated using the Fisher’s least significant difference (LSD) method at P > 0.05 (Ihekoronye and Ngoddy, 1985)

RESULTS AND DISCUSSION

Functional properties of flour samples

The functional properties of the flour samples are shown on Table 3. The results show that the bulk density, swelling index, water and oil absorption capacities increased steadily with increased maize substitution of the flour. The bulk density increased significantly from 0.81 g/cm^3 for the 100% wheat flour to 0.95 g/cm^3 for the 80:20 wheat-maize flour. This is very important in packaging and material handling since high bulk density enables a higher amount of material occupy a smaller volume (Karma et al., 1981).

Water absorption capacity increased from a value of 2.05g/g for the 100% wheat flour to 2.52g/g for the 80:20 wheat/maize flour. It has been reported by Shittu et al. 2008 that baking quality is a function of water absorption capacity of the flour.

The oil absorption capacity also increased slightly from 2.3 g/g for the 100% wheat flour to 2.66 g/g at 20% maize substitution. The wettability of the flour increased with
increase in substitution with maize flour. With the composite flours being wetted within shorter time. The swelling index also increased from 1.45 to 1.96 as the substitution increased from 0 to 20% maize.

**Proximate composition of flour samples**

The results of the proximate analysis is shown on Table 4. The data shows that the ash, moisture, fat, total dietary fibre, and carbohydrate levels increased with increase in level of maize substitution, while the protein content decreased.

Maize flour has higher content of ash, moisture, fat and dietary fibre which explains the slight increases in these components with increased substitution. (Whistler et al., 1984; Potter and Hotchkiss, 1985). However the protein content of the maize flour bring lower than that of wheat resulted in a decrease in protein content with increase in level of substitution.

**Results of sensory evaluation of bread samples**

The results are shown on Tables 5 and 6. The results show a steady decrease in the mean scores for all of the parameters as maize substitution increases. However,
the mean value for overall acceptability was highest for the 95% wheat maize bread with a value of 6.78 but decreased steadily to 6.27 for the 80:20 wheat maize bread.

The result show that significant differences exist among the bread samples produced using the different methods. The mean value for texture was highest 6.7 for the sponge and dough method, taste and aroma did not show any significant difference except for the bread produced through the sour dough method which had significantly lower values (5.7). The crust and crumb colour and overall acceptability was highest for the No-time dough method with value of 7.1, 6.9 and 6.8 respectively.

Results of sensory evaluation of cake samples

No significant difference was observed in the mean values for the texture, taste, aroma, crust and crumb colour as well as overall acceptability (Table 7). This suggests that all the sample flours were well suited for cake production.

However, the mean sensory scores obtained from the cake making methods showed that the whisking method of cake production gave products with significantly lower values for all the parameters tested (Table 8). Cake produced from the other methods did not show any significant differences in the parameters tested.

Physical properties of the bread and cake samples

The results shown on Table 9 reveal that no significant difference (P ≥ 0.05) was observed in the weight of the bread samples. The values ranged from 301.8 to 307.1 g. Mean values for the volume and specific volume were significantly lower (P < 0.05) when the flour was substituted with 15 and 20% maize flour.

For the bread methods, the sponge and dough method gave the highest weight (309.2 g) while the sour dough method gave the significantly (P < 0.05) lowest volume and specific volume of 290.6 g (Table 10). However the lowest volume and specific volume was obtained from the sponge and dough method which suggests that this method is less suited for use with wheat maize composite flour. However the
Table 10. Results obtained from the physical analysis of bread samples using different bread making methods.

<table>
<thead>
<tr>
<th>Methods</th>
<th>Weight of bread</th>
<th>Volume (cm³)</th>
<th>Specific volume (cm³/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No time dough</td>
<td>309.2±2.59⁵</td>
<td>1222.0±18.92</td>
<td>3.95±0.05⁴</td>
</tr>
<tr>
<td>straight dough</td>
<td>306.7±4.80⁵</td>
<td>1113.2±58.123</td>
<td>3.63±0.214³</td>
</tr>
<tr>
<td>Sponge and dough method</td>
<td>310.9±7.84⁵</td>
<td>984.9±61.51⁵</td>
<td>3.16±0.127²</td>
</tr>
<tr>
<td>Sour dough</td>
<td>290.6±2.16⁵</td>
<td>1194.1±141.88</td>
<td>4.11±0.507³</td>
</tr>
</tbody>
</table>

Means on the same column with different superscript are significantly different at (p<0.05).

Table 11. Results obtained from the physical analysis of the cake samples

<table>
<thead>
<tr>
<th>Sample wheat : maize</th>
<th>Weight</th>
<th>Volume (cm³)</th>
<th>Specific volume (cm³/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100:0</td>
<td>157.8±11.010⁵</td>
<td>322.7±22.38⁶</td>
<td>2.06±0.20⁴</td>
</tr>
<tr>
<td>95:5</td>
<td>157.7±11.22⁵</td>
<td>338.2±49.74⁵</td>
<td>2.14±0.18⁴</td>
</tr>
<tr>
<td>90:10</td>
<td>163.3±18.07⁵</td>
<td>353.7±37.49⁵</td>
<td>2.17±0.03⁴</td>
</tr>
<tr>
<td>85:15</td>
<td>161.2±9.41⁵</td>
<td>339.8±61.65⁵</td>
<td>2.10±0.31⁴</td>
</tr>
<tr>
<td>80:20</td>
<td>163.4±19.25⁵</td>
<td>355.1±98.22⁵</td>
<td>2.01±0.42⁵</td>
</tr>
</tbody>
</table>

Means on the same column with different superscripts significantly different at (p < 0.05).

Table 12. Results obtained from the physical analysis of the cakes using different cake making methods.

<table>
<thead>
<tr>
<th>Methods</th>
<th>Weight</th>
<th>Volume (cm³)</th>
<th>Specific volume (cm³/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creaming</td>
<td>172.4±11.36⁵</td>
<td>390.98±35.33⁵</td>
<td>2.27±0.09⁴</td>
</tr>
<tr>
<td>Melting</td>
<td>155.7±9.13⁵</td>
<td>346.29±27.59⁵</td>
<td>2.23±0.11⁴</td>
</tr>
<tr>
<td>Rubbing in</td>
<td>167.52±6.66⁵</td>
<td>359.95±18.41⁵</td>
<td>2.15±0.08⁴</td>
</tr>
<tr>
<td>whisking</td>
<td>147.08±13.7⁵</td>
<td>254.45±44.41⁵</td>
<td>1.73±0.13⁵</td>
</tr>
</tbody>
</table>

Means on the same column with different superscripts significantly different at (p < 0.05).

sough dough method gave the significantly (P < 0.05) highest volume (1194.1 cm³) and specific volume (4.11 cm³/g). This may be attributed to the fact that this method gives a well developed gluten network which is essential in maintaining bread volume.

No significant difference (P > 0.05) was observed in the cake weight, volume and specific volume for all the cake samples with values ranging from 157.8 to 163 g for weight (Table 11), 322.7 to 335.1 cm³ for the volume and 2.01cm³/g to 2.01cm³/g for specific volume.

The results from the methods show that the creaming method gave the highest weight (172.4 g) volume (390.98 cm³) and 2.27 cm³/g for specific volume (Table 12). While the whisking method gave the lowest weight (147.08 g), volume 254.45 cm³ and 1.73 cm³/g which were significantly different (P < 0.05) from the others.

Conclusion

Although, the functional properties and proximate composition of the wheat : maize composite flours were slightly different from that of 100% wheat flour, it was found that bread baked with 5 and 10% composite flour were not significantly different in most the sensory attributes and overall acceptability from the control(100% wheat flour). For the bread making methods, no-time was found to be the best method in most of the sensory attributes and overall acceptability. Generally, sponge and dough method gave the best crumb texture, in terms of crust colour no-time and sourdough method are not significantly different. However for the crumb texture, the no-time dough, straight dough and sour dough method are not significantly different.

For cake, it has been found that cake baked with 5, 10, 15 and 20% composite flour were not significantly different in all the sensory attributes and overall acceptability from the control (100%). While the creaming method was found to be the best method followed by melting method and rubbing-in method in most of the sensory attribute and overall acceptability.

REFERENCES


