EFFECT OF ADDITION OF TIGERNUT AND DEFATTED SESAME FLOURS ON THE NUTRITIONAL COMPOSITION AND SENSORY QUALITY OF THE WHEAT BASED BREAD

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Abstract
The aim of this research was to promote value addition of wheat based bread by the utilization of local plant resources such as tigernut and sesame. The effect of addition of tigernut and increasing substitution of defatted sesame flours on proximate and mineral compositions and the sensory properties of the wheat based bread were evaluated. Tigernut and sesame were processed into flours, which were used partially in substituting the wheat flour. Six blend ratios and codes of 100:0:0 (sample A), 90:10:0 (sample B), 85:10:5 (sample C), 80:10:10 (sample D), 75:10:15 (sample E) and 70:10:20 (sample F) were developed for wheat, tigernut and defatted sesame flours respectively. For the proximate composition of the bread samples, the protein, fat, ash and fibre contents of all the samples increased significantly with addition of tigernut flour and increasing substitution with defatted sesame flour, while carbohydrate content decreased. The mineral composition (calcium, zinc, magnesium and iron) of the samples all increased with addition of tigernut flour and increasing incorporation of defatted sesame flour. The sensory attributes of sample C compare favourably with sample A. The study revealed that it is possible to produce composite bread by partially substituting the wheat flour with the incorporation of tigernut and defatted sesame flours. This will go a long way in improving the socio-economic status of local farmer, reduce the over-dependence on wheat, boost the use of more local plant resources and make bread more affordable and available.

Keywords: bread, tigernut flour, defatted sesame flour, macro/micro nutrients, sensory scores

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1. INTRODUCTION

Bread can be described as a fermented confectionary produced mainly from wheat flour, water, yeast and salt by a series of processes involving mixing, kneading, proofing, shaping and baking (Ahemen *et al*., 2018). It is one of the major staple foods that are consumed in different parts of the world. Its consumption is continuously increasing in countries like Nigeria, as a result of, growimg population, rural-urban migration and working conditions (Alozie *et al*., 2009). Bread has good nutritional composition of protein, fiber, carbohydrate, vitamins and minerals. The basic ingredients required for bread production are flour, water, yeast or baking powder and salt. Optional bread enriching ingredients could be sugar/sweeteners, milk, fats, egg, fruits and fruit juices, spices, enzymes and dough conditioners (e.g. lemon juice and malt extract).

Wheat is unique among many other cereal grains because of its high content of gluten protein, a property that makes bread dough stick together and retain gas (David *et al*., 2015). It contains 2-3% germ, 13-17% bran and 80-85% endosperm, which is the source of white flour (Šramková *et al*., 2009). Nutritionally, the whole grain contains 78.10% carbohydrates, 14.70% protein, 2.19% fat, 2.10% minerals and considerable proportions of vitamins (thiamine and vitamin-B) (Kumar *et al*., 2011). Its flour can be of great benefit for the production of bread, biscuits, confectionary products, noodles and the important gluten of wheat. Wheat is also used as animal feed, for ethanol production, brewing of wheat beer, wheat base raw material for cosmetics and wheat protein in meat substitutes to make straw composites (Shewry, 2009). Tigernuts have a rich repository of valuable nutritious starch as well as dietary fibre. It has been demonstrated to be high in lysine than those proposed in the protein standard by the FAO/WHO for satisfying adult needs (Aremu *et al*., 2015), thus serving as a good supplement for both sesame and wheat. Tigernut flour (yellow variety) contains 46.99% carbohydrates, 7.15% protein, 32.13% fat, 6.29% crude fibre and 3.97% ash (Adejuyitan, 2011). Its flour is considered to be a good additive for baking as its sugar content is fairly high, avoiding the necessity of adding too much extra sugar (Sánchez-Zapata *et al*., 2012). Sesame (*Sesamum indicum* L.), otherwise known as sesamum or benniseed (member of the family Pedaliaceae), is a tropical plant that is remarkably produced for its seeds and oil (Ikwuakam and Lawal, 2015). Sesame seed contains 50% oil, 25% protein, 20–25% carbohydrate and are rich sources of iron, magnesium, copper and calcium (Gebremichael, 2017). The seed also contains phytosterols associated with reduced levels of blood cholesterol (Zerihun, 2012). It is reported that defatted sesame flour contains 55.70% protein, 29.10% carbohydrate, 9.83% ash and 1.64% crude fiber (Chinma *et al*., 2012) which if added to recipes; it can give the right balance of nutrients to a food product. Their dietary protein contains fine quality amino acids that are essential for growth especially in children (Tunde-Akintunde *et al*., 2012). Sesame seeds are very good source of B-complex vitamins and many essential minerals that have vital role in bone mineralization and red blood cell production (Tunde-Akintunde *et al*., 2012). Sesame increase plasma gamma tocopherol and enhances vitamin E activity which is known to prevent cancer and heart diseases (Chinma *et al*., 2012).

Malnutrition continues to be a great cause for concern especially among Nigerian children. The incidence of malnutrition is more prevalent in the northern states than elsewhere in the country, accounting for over 70% of child population. It contributes to the death of about 2,300 children, below the age of 5, annually (Premium Times, 2016). World Health Organization also affirms that 35% of death among Nigerian children under age of 5 is caused by malnutrition (African Examiner, 2015). Not only does malnutrition threatens the socio-economic prosperity of the community, it leads to a decline in the physical and cognitive abilities of children.

The continuous utilization of wheat which is imported, as a basic ingredient in bread making has led to an increase in the cost of bread production, making it increasingly less affordable for low income consumers who constitute the larger population. In order to reverse this trend, the Food and Agricultural Organization (FAO) and the Nigerian government have been encouraging the production of bread made from composite flours with less emphasis on wheat and more attention on locally grown crops. Several reports have shown the production of bread using different composite flour blends from wheat-soybean (Udofia *et al*., 2013), wheat-acha-cowpea (Olapade and Oluwole, 2013), wheat-sesame (Iombor *et al*., 2016), maize-sweet potato (Bibiana *et al*., 2014), wheat-yeast fermented rice bran (Chinma *et al*., 2015) and wheat-plantain (Shittu *et al*., 2014). To the best of our knowledge, no research has been carried on the possibility of producing bread from composite flour blends from wheat-tigernut-defatted sesame, hence their adoption for bread production and evaluation. The partial substitution of wheat by the inclusion of tigernut and sesame will not only encourage their utilization, but will add value, improve the socio-economic status of Nigeria's local farmers, provide nourishment to malnourished children and people with chronic disease conditions, minimize complete dependence on imported wheat flour and save foreign exchange for the country.

2. MATERIALS AND METHODS

Source of raw materials

Wheat flour (Golden Penny), sesame seeds (white variety), sugar, dry baker's yeast and fat (Margarine) were purchased from Modern market, while dried tigernut tubers (black variety) were obtained from Wadata market; all in Makurdi, Benue State, North-Central Nigeria. Equipment/materials such as blender, mixer, kneader, knife, digital weighing scale, measuring cylinder, boiler, baking pans, plastic bowls, plastic containers with lids, stirrer, 0.45mm mesh size sieve, Petri dishes, Spoons, Spatula, Portable water and oven were obtained in the Postgraduate Laboratory of Centre for Food Technology and Research, Benue State University, Makurdi. All chemicals used were of analytical grade

Preparation of tigernuts flour

The method reported by Ade-Omowaye *et al.* (2008) was adopted in the preparation of tigernut flour, with slight modification. Dry tigernuts (black variety) tubers were sorted to remove unwanted materials like stones, pebbles and other foreign seeds, before washing with portable water dried in an oven at 80 ^oC. The dried nuts were milled (Attrition mill) and sieved through 0.45 mm aperture size. The resultant flour was packed in polyethylene bag and stored in a plastic container with air-tight lid at room temperature.

Preparation of defatted sesame flour

The method described by Chinma *et al.* (2012) was adopted in the preparation of defatted sesame flour. The sesame seeds were sorted to remove bad seeds and other foreign materials. The seeds were soaked overnight in cold tap water at ambient temperature and the hulls completely removed by floatation technique through hand rubbing. The dehulled seeds were blanched in water for 5 min, dried at 60 ^oC in an oven and milled into flour using attrition mill to obtain the full fat sesame flour. The flour was then passed through a 0.45 mm mesh size sieve. A 500 g of full fat sesame flour was poured in a white muslin cloth and immersed in aluminum pan containing one liter of petroleum ether (P.E) for 48 h to extract the oil. The meal was air dried for 1 h and milled using a blender (Binatone, BLG-402). The flour was then passed through a 0.45 mm mesh size sieve and stored in plastic containers with lids at 4 ^oC in a refrigerator for future use.

Production of composite flour from wheat, tigernut and defatted sesame

Six samples, A-F were designed for this study. Only sample A had 100% wheat flour, while the rest of the samples had 10% tigernut flour incorporated in them. The defatted sesame flour was substituted at 5%, 10%, 15% and 20% into samples, C-F respectively. All blend formulations were thoroughly mixed with the aid of a blender (Binatone, BLG-402) to produce composite flour as shown in Table 1.

Production of the wheat-tigernut-defatted sesame composite bread

Bread was produced using the straight dough method as reported by Chauhan *et al.* (1992). All the ingredients (flour, sugar, yeast, fat and water) were thoroughly mixed manually for 40 min. The mixture was kneaded properly until dough became elastic.

Table 1: Recipe formulation of composite flour and other ingredients for bread production

	Samples					
Ingredients	**A**	**B**	**C**	**D**	**E**	**F**
Wheat flour (g)	100	90	85	80	75	70
Tigernut flour (g)	0	10	10	10	10	10
Defatted Sesame flour (g)	0	0	5	10	15	20
Sugar (g)	12	12	12	12	12	12
Yeast (g)	3	3	3	3	3	3
Fat (g)	16	16	16	16	16	16
Water (mL)	85	85	85	85	85	85

Legend: Sample A=Control I= 100% Wheat flour; Sample B= Control II= 90% Wheat flour: 10% Tigernut flour; C=85% wheat flour, 10% tigernut flour and 5% defatted sesame flour; D=80% wheat flour, 10% tigernut flour and 10% defatted sesame flour; E=75% wheat flour, 10% tigernut flour and 15% defatted sesame flour and F=70% wheat flour, 10% tigernut flour and 20% defatted sesame flour.

The kneaded dough was transferred into greased (with margarine) baking pans and covered with aluminum foil. It was allowed to ferment for 55 min at room temperature. The fermented dough was allowed to undergo proofing at room temperature for 90 min. It was then transferred to the oven (Century electric oven, model 8320-A20L) for baking at 230 ^{o}C for 30 min. The loaves were removed from the pans and allowed to cool before packaging in polyethylene bags.

Determination of proximate composition

The moisture, ash, fat, crude fibre, and protein contents of the bread were determined using the AOAC (2012) methods, while the carbohydrate content was carried out using the method of Alozie *et al*. (2009).

Determination of mineral composition

The method described by AOAC (2005) was carried out for mineral analysis. The ash obtained from the ash analysis earlier was used in the determination of the mineral content. The ash was placed in porcelain crucibles, and then few drops of distilled water were added, followed by 2 mL of concentrated hydrochloric acid. 10 mL of 20% HNO_3 were added and evaporated on the hot plate. The samples were filtered through Whatman filter paper into 100 mL volumetric flask. The mineral elements; calcium, magnesium, iron and zinc were determined by atomic absorbance spectrophotometer (PG Instruments/PG990).

Sensory evaluation

The sensory evaluation of the bread samples was analyzed based on appearance, taste, aroma, crust colour, crumb colour and general acceptability of the product by a fifteen man panel on a 9 point hedonic scale (where 1 = extremely disliked, 9 = extremely liked) as described by Ihekoronye and Ngoddy (1985).

Statistical analysis

All data obtained were analyzed in duplicate determinations. They were subjected to Analysis of Variance (ANOVA) using Statistical Package for Social Sciences (SPSS) version 20.0 to test the level of significant difference at 5% level of probability ($p<0.05$). Duncan Multiple Range Test was used to separate the means where significant differences existed.

3. RESULTS AND DISCUSSION

Proximate composition of wheat-tigernut-defatted sesame composite bread samples

The result in Table 2 shows the effect of adding tigernut and increasing substitution of wheat with defatted sesame flours on the proximate composition of the formulated bread samples. Percentage crude protein ranged from 10.79±0.01% to 15.30±0.00%. Samples, F and A had the highest and lowest protein contents respectively. There was no significant difference between samples A and B, and, samples E and F. But there was significant difference between samples A, C, D and E, and samples B, C, D and E.

The protein content increased with increasing levels of defatted sesame flour in the various blend formulations. This agrees with the works of (Dabels *et al*., 2016; Dooshima *et al*., 2014) who reported increase in protein content of bread from wheat, acha and mung bean, and, wheat, defatted soy and banana flours, respectively. Defatted sesame has a protein content of 55.7% (Chinma *et al*., 2012), and so may be suggested to be responsible for the trend observed in the current study. Percentage crude fat of bread samples increased with addition of tigernut and increasing incorporation of defatted sesame flours. Significant difference existed among samples.

The fat content ranged from 6.76±0.01% to 7.97±0.01% with samples F and A, having the highest and lowest values respectively. The increase could be due to the inclusion of tigernut and increasing levels of defatted sesame flours, which contains some level (22.14% and 4.54 g/100g respectively) of fat. The crude fibre content increased from 0.56±0.01% (Sample A) to 1.80±0.00% (Sample F).

Table 2: Proximate composition of wheat-tigernut-defatted sesame composite bread samples

Samples	Protein%	Fat%	Fibre%	Ash%	Moisture	Carbohydrate%
A	$10.79^{a}\pm 0.01$	$6.76^{a}\pm 0.01$	$0.56^{a}\pm 0.01$	$5.65^{a}\pm 0.01$	$19.57^{b}\pm 0.02$	$56.71^{e}\pm 0.01$
B	$10.95^{a}\pm 0.01$	$7.11^{b}\pm 0.01$	$1.44^{b}\pm 0.01$	$5.70^{b}\pm 0.06$	$19.45^{a}\pm 0.01$	$55.37^{d}\pm 0.01$
C	$12.22^{b}\pm 0.01$	$7.32^{c}\pm 0.01$	$1.50^{c}\pm 0.00$	$7.20^{c}\pm 0.00$	$19.63^{b}\pm 0.00$	$52.14^{c}\pm 0.04$
D	$13.87^{c}\pm 0.01$	$7.75^{d}\pm 0.00$	$1.65^{d}\pm 0.01$	$7.50^{d}\pm 0.01$	$20.20^{c}\pm 0.01$	$49.66^{b}\pm 0.06$
E	$15.25^{d}\pm 0.71$	$7.86^{e}\pm 0.01$	$1.75^{e}\pm 0.00$	$7.83^{e}\pm 0.02$	$20.66^{d}\pm 0.01$	$46.66^{a}\pm 0.74$
F	$15.30^{d}\pm 0.00$	$7.97^{f}\pm 0.01$	$1.80^{f}\pm 0.00$	$8.00^{f}\pm 0.00$	$21.03^{e}\pm 0.04$	$45.91^{a}\pm 0.02$

Means with same superscript within the column do not differ significantly at 5% level of confidence, ± = standard deviation of duplicate determinations.

Legend: A=100% wheat flour; B=90% wheat flour, 10% tigernut flour and 0% defatted sesame flour; C=85% wheat flour, 10% tigernut flour and 5% defatted sesame flour; D=80% wheat flour, 10% tigernut flour and 10% defatted sesame flour; E=75% wheat flour, 10% tigernut flour and 15% defatted sesame flour and F=70% wheat flour, 10% tigernut flour and 20% defatted sesame flour.

Tigernut is said to be high (25.23%) in dietary fibre (Chukwu, *et al*., 2013) and thus, it may be suggested that the increase in fibre could be attributable to the addition of tigernut flour.

Defatted sesame flour also contains some amount (3.41% and 5.49g/100g) of fibre (Chinma *et al*., 2015; Ogungbenle and Onoge, 2014). The values obtained from this study were lower than the values of 2.29 - 2.80% and 0.3 - 3.2% reported by (Ade-Omowaye *et al*., 2008; Ezeocha and Onwuneme, 2016) respectively. All composite breads had fibre content that were within the recommended range for diets of not more than 5g dietary fibre per 100g dry matter (FAO/WHO, 1994). The ash content which gives a measure of the mineral content of the food material increased significantly as the amount of defatted sesame flour inclusion increased. The ash content ranged from 5.65±0.01% to 8.00 ±0.00% with Samples F and A, recording the highest and lowest values respectively. These values were higher than those reported by Ezeocha and Onwuneme, 2016) for bread produced from wheat, sweet potato and tigernut flours. This suggests that samples with increased percentage of ash will have good repository of minerals. The moisture content ranged from 19.45±0.01% (sample A) – 21.03±0.02% (sample F). Moisture content increased with increase substitution of defatted sesame flour. Similar observation was made by Makinde and Akinoso (2014) on wheat–black sesame bread, where an increase in moisture content with increased sesame flour was observed. There was no significant difference between samples A and C. However, there was significant difference between samples A, B, D, E, and F and between samples C, B, D, E and F. Carbohydrate content decreased from 56.71 ±0.01% to 45.91±0.02% with Sample A recording the highest value (56.71±0.01%) and sample F, the least (45.91±0.02%). Samples E and F were not significantly different from each other, but were different significantly from A, B, C and D. The reduction in the carbohydrate content may be as a result of the low carbohydrate content of defatted sesame flour, as observed in similar works using sesame seeds (Makinde and Akinoso, 2014).The bread samples with low carbohydrate content will be more useful than 100% wheat bread for people suffering from chronic degenerative disease conditions such as obesity, hypertension and diabetes. Such people will require protein-rich and low carbohydrate foods.

Mineral composition of wheat-tigernut-defatted sesame composite bread samples

Results of the mineral composition of wheat-tigernut-defatted sesame composite bread samples are shown in Table 3. The iron (Fe) in the analyzed samples ranged from 6.23±0.01 – 6.85±0.00 mg/100g with samples, A and F recording the lowest and highest values respectively. Samples, E and F do not differ significantly, but they were significantly different from samples A, B, C and D. The values obtained from the study were higher than the values obtained by Igbabul *et al.* (2014), and lower than the values reported by Adebayo-Oyetoro *et al.* (2016) on wheat, maize and orange fleshed sweet potato flours, and wheat and fermented banana flours, respectively.

Table 3: Mineral composition of wheat-tigernut-defatted sesame composite Bread samples (mg/100g)

Sample	Iron	Calcium	Magnesium	Zinc
A	$6.23^{a}\pm0.01$	$63.25^{a}\pm0.01$	$163.53^{a}\pm0.01$	$7.26^{a}\pm0.14$
B	$6.35^{b}\pm0.00$	$127.25^{b}\pm0.00$	$211.31^{b}\pm0.01$	$7.96^{b}\pm0.01$
C	$6.48^{c}\pm0.01$	$148.23^{c}\pm0.01$	$246.98^{c}\pm0.00$	$10.43^{c}\pm0.01$
D	$6.62^{d}\pm0.01$	$165.34^{d}\pm0.01$	$266.47^{d}\pm0.01$	$13.62^{d}\pm0.02$
E	$6.84^{e}\pm0.02$	$177.85^{e}\pm2.84$	$271.31^{e}\pm0.02$	$14.24^{e}\pm0.02$
F	$6.85^{e}\pm0.00$	$190.32^{f}\pm0.01$	$288.73^{f}\pm0.02$	$15.08^{f}\pm0.01$

Means with same superscript within the column do not differ significantly at 5% level of confidence, ± = standard deviation of duplicate determinations.

Legend: A=100% wheat flour; B=90% wheat flour, 10% tigernut flour and 0% defatted sesame flour; C=85% wheat flour, 10% tigernut flour and 5% defatted sesame flour; D=80% wheat flour, 10% tigernut flour and 10% defatted sesame flour; E=75% wheat flour, 10% tigernut flour and 15% defatted sesame flour and F=70% wheat flour, 10% tigernut flour and 20% defatted sesame flour.

The iron content of all samples falls below the Recommended Daily Allowance (RDA) of 10 and 15 mg/day for children and female adult respectively. However, the bread could be a source of iron to consumers. Iron is required for blood haemoglobin formation (Ogungbenle and Onoge, 2014). Sample F has the highest value of 190.32±0.01 mg/100g, while sample A has the lowest value of 63.25±0.01 mg/100g for calcium content. The values are below the RDA of 1000mg for adults and children aged four years and older (Alakali *et al*., 2016). Ndung'u *et al*. (2015) on wheat bread supplemented with oyster mushroom, reported values (1.16 to 1.77 g/100g) above the values obtained in the present study. Calcium is an important constituent of teeth and bone and is actively involved in the regulation of nerve and muscles function (Ogungbenle and Onoge, 2014). Magnesium content (Mg) increased with the addition of tigernut and increasing levels of defatted sesame flours. Sample F had the highest value of 288.73±0.02 mg/100g and sample A had the lowest value of 163.53±0.01 mg/100g. The Mg content falls below the Recommended Daily Allowance (RDA) of 420 mg/day for men and 310 mg/day for women (Alakali *et al*., 2016). In addition, values obtained from the study were higher than the values of 28.27 to 28.74 g/100g reported by Ndung'u *et al*. (2015). Magnesium helps regulates diverse biochemical reaction in the body, including the protein synthesis, muscles and nerve function, blood pressure regulation and insulin release, it also keeps bone strong (Huskisson *et al*., 2007). From the result, it is evident that the zinc (Zn) content increased from 7.26±0.14 – 15.08±0.01 mg/100g with the least and highest values being recorded by Samples, A and F respectively. There were significant variations among the samples. Zinc aids the growth and repair of tissues, boosts the immune system and plays an important role in sperm survival. WHO recommends zinc intake of 15 and 10 mg/day for adults and children, respectively (Ogungbenle and Onoge, 2014). Thus, the bread has a good reserve of Zinc which will impart positively on consumers' health.

Sensory evaluation of wheat-tigernut-defatted sesame composite bread samples

Results of the sensory analysis of wheat-tigernut-defatted sesame composite bread blend formulations are shown in Table 4. The mean sensory scores for crust colour decreased from 8.40±0.51 to 7.87±0.53. Sample A had the highest score of 8.40±0.51 and F had the lowest score (7.87±0.53). There were no significant variations between samples, A and B; C and D; and E and F respectively. Scores for crumb colour decreased, with sample A having the highest score (8.20±0.56) and sample F having the least score (4.60±0.99). There was no significant variation between samples, A, B and C, but samples, D, E and F differed significantly. The colour of the crumb became darker as the level of substitution with defatted sesame flour increased. This could be attributed to the combined effect of the black tigernut and defatted sesame flours. Colour is an index used for determining the initial acceptability of baked products by the consumer.

Table 4: Sensory analysis of wheat-tigernut-defatted sesame composite bread samples

Sample	Crust colour	Crumb colour	Aroma	Taste	Texture	General acceptability
A	$8.40^{d}\pm0.51$	$8.20^{d}\pm0.56$	$8.33^{b}\pm0.72$	$8.40^{c}\pm0.74$	$7.20^{a}\pm0.56$	$8.33^{b}\pm0.72$
B	$8.33^{d}\pm0.49$	$8.13^{d}\pm0.64$	$8.27^{b}\pm0.70$	$8.33^{c}\pm0.72$	$7.13^{a}\pm0.64$	$8.27^{b}\pm0.70$
C	$7.93^{bc}\pm0.46$	$8.00^{d}\pm0.65$	$8.40^{b}\pm0.63$	$8.40^{c}\pm0.63$	$6.93^{a}\pm0.59$	$8.27^{b}\pm0.59$
D	$7.93^{bc}\pm0.46$	$6.73^{c}\pm0.59$	$8.40^{b}\pm0.63$	$5.87^{b}\pm0.92$	$6.73^{a}\pm0.59$	$6.93^{a}\pm0.59$
E	$7.87^{a}\pm0.52$	$5.80^{b}\pm0.77$	$5.80^{a}\pm0.94$	$5.53^{ab}\pm0.74$	$6.80^{a}\pm0.68$	$6.33^{a}\pm0.98$
F	$7.87^{a}\pm0.53$	$4.60^{a}\pm0.99$	$5.13^{a}\pm1.06$	$4.93^{a}\pm0.46$	$6.80^{a}\pm0.68$	$6.07^{a}\pm1.16$

Means with same superscript within the column do not differ significantly at 5% level of confidence, ± = standard deviation of duplicate determinations.

Legend: A=100% wheat flour; B=90% wheat flour, 10% tigernut flour and 0% defatted sesame flour; C=85% wheat flour, 10% tigernut flour and 5% defatted sesame flour; D=80% wheat flour, 10% tigernut flour and 10% defatted sesame flour; E=75% wheat flour, 10% tigernut flour and 15% defatted sesame flour and F=70% wheat flour, 10% tigernut flour and 20% defatted sesame flour.

Similar effect (darkness) on crumb colour was observed when wheat flour was substituted at different levels of black sesame [34].

From the results, quality score for Aroma of the breads ranged from 5.13±1.06 − 8.40±0.63. Samples A, B, C and D were rated highly by the panelist and were not significantly different from each other. The high scores observed for samples C and D could be due to the nutty flavour from the defatted sesame flour which may have been imparted into the bread samples. Scores for taste ranged from 4.93±0.46 − 8.40±0.74. Samples A and C had the highest mean scores taste and sample F had the lowest value. There was no significant difference between samples A, B and C, but were significantly different from D, E and F. Samples prepared from substitution of defatted sesame above 5% were poorly rated for the sensory parameter, taste. This could be due to the bitter taste of some inherent compounds in defatted sesame flour. also reported similar observations for bread substituted with black sesame above 5%. The score for texture decreased from 7.20±0.56 to 6.73±0.59 with sample A having the highest score and sample D, the least score. For all the samples, there was no significant difference between each one of them. Adebayo-Oyetoro *et al*. (2016) also observed a decrease in crumb texture preference for wheat-fermented banana flours. Sensory analysis result showed that bread from 100% wheat flour and that produced from composite flour made with 10% tigernut and 5% defatted sesame were rated alike in almost all the quality attributes evaluated.

4. CONCLUSION

The study has demonstrated that bread of good nutritional and sensory qualities could be produced from composite flours of wheat, tigernut and defatted sesame, at 85%, 10% and 5%, respectively. In terms of proximate composition, the crude protein (10.79 – 15.30%) and fibre (0.56 – 1.89%) increased with increased substitution of wheat flour with defatted sesame flour, and, the addition of tigernut flour in the breads. There was an improvement in the macro- and micro-nutrient compositions of the composite breads as a result of the addition of tigernut flour and increasing levels of defatted sesame flour. The sensory attributes of the bread produced from 10% tigernut, 5% defatted sesame and 85% wheat flour blends compared favourably with 100% wheat flour bread. All the other bread products were of acceptable quality on a 9 point hedonic scale. The study concluded that it is possible to produce composite bread by substituting the wheat flour with the incorporation of tigernut and increasing addition of defatted sesame flours. This will go a long way in improving the socio-economic status of local farmers, reduce the over-dependence on wheat, boost the use of more local plant resources and make bread affordable and available especially for the low income consumers.

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