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Effect of Added Sesame Seed on Quality Characteristics of Wheat Bread

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Abstract

This study evaluated the effect of added sesame seed on characteristics of wheat bread. The wheat and composite flours were used to bake five bread samples containing 0%, 10% or 20% of the crushed or uncrushed sesame seed, using standard method of baking bread. The bread samples were produced. Samples were analyzed for nutrient composition and sensory characteristics within 3 days. Sesame seed improved protein, fat, vitamin and minerals contents but decreased carbohydrate and moisture contents of the bread samples. Protein content (%) increased from 8.71, fat (%) from 3.26, ash (%) from 2.51 in B1 (O% sesame, the control) to 11.3, 10.63 and 6.27 in B3 (with 20% crushed sesame) respectively. The mineral contents (mg/100g), including zinc, iron, calcium, magnesium and phosphorus improved significantly ($p > 0.05$) with increasing sesame seed contents in the bread samples. Phosphorus content (mg/100g) increased from 146.8 in B1 (with 0% sesame) to 275.4 in B5 (with 20% uncrushed sesame). Iron contents (mg/100g) increased from 1.15 (with 0% sesame) in B1 to 2.29 in B3 (with 20% crushed sesame). Also sesame seed addition improved total phenol content (mg/100g) from 0.37 in B1 to 0.62 in B3 and anthocyanins (mg/100g) from 0.76 in B1 to 0.85 in B5. All the bread samples were acceptable to panelists. However, the control (0% sesame) was more acceptable than every other sample and was followed by sample B2 with 10 % crushed sesame seed. Sesame seed improved quality of bread.

Key words: Sesame, Seed, Composite, Bread, Quality, Flour

Introduction

Bread is a staple food prepared by baking dough usually made from wheat flour. Bread is popular globally and is one of the oldest food (Heinio, Luikkonen, Katina, Myllyinki and

Poutaman, 2003). It is widely accepted and consumed throughout the world (O'Brian,2003). In Nigeria, wheat is produced in limited quantity while a greater proportion of wheat flour is imported to meet local flour needs for bakery products. Bread is made of about 60% wheat which is the base ingredient (Akubor, 2003). The impact of various ingredients, other than wheat on sensory and nutritional quality of bread have been extensively studied (Heinio *et al*., 2003; Barcenas and Rossel., 2005; Plessas, Pherson, Bekatou, Nigarn, & Koutinas., 2005)

Wheat flour is conventionally preferred to other cereal flours for bakery products such as cakes, pie and bread because of its special protein quality. Wheat has four distinct proteins namely albumin, globulin, gliadin and glutenin. Glutenin and gliadin are collectively called gluten (Enwere, (1998). The wheat gluten is responsible for the distinctive baking quality of wheat flour rarely found in other cereal flours. Gluten protein is capable of retaining carbon-dioxide generated by the leavening agents during fermentation of the dough. Unfortunately, wheat, like other cereal grains, is deficient in the essential amino acid lysine which is abundant in most legumes, but rich in methionine and cystine which are limiting in legumes (Enwere, (1998). Composite blends of wheat and legumes complement these essential amino acids. Wheat is a temperate crop, and the wheat flour consumed in Nigeria and other tropical countries is imported (Khan and Zeb, 2007).

Evidence from food consumption survey in Nigeria revealed an increasing demand for bread, cookies and pasta, all of which are made from wheat flour. So, Nigeria's demand for wheat-based products is on the increase (Bojňanská *et al*., 2012). This would increase Nigeria's foreign expenditure. Again, researchers have shown that wheat could pose some health problems such as celiac diseases to regular wheat consumers (Mohammed *et al*., 2012). Combining wheat with indigenous grains for composite flours is considered advantageous in developing countries as it reduces the importation of wheat flour and encourages the use of locally grown food crops (Hugo *et al*., 2000; Noorfarahzilah *et al*., 2014; Hasmadi *et al*., 2014). This is particularly increasing due to the growing mark*et* for confectioneries (Noor Aziah and Komathi, 2009). Thus, several developing countries have encouraged the initiation of programmes to evaluate the feasibility of alternative locally available flours as a substitute for wheat flour (Abdelghafor *et al*., 2011).

Fortunately, Nigeria is endowed with grain legumes, including soybean, cowpea, pigeon pea, African yam bean, jack bean and sesame, each of which could be combined with wheat in bread production. Sesame is locally produced and readily available in the Nigeria. Sesame seed is rich in protein and has high antioxidant properties (Cheung *etal,* 2007). Sesame is also rich in unsaturated fatty acids, fibers and mineral. The crop is cultivated in large quantity in the North Central region of Nigeria, precisely in Nasarawa, Benne, Niger, Kogi and Taraba States.

Wheat when combined with sesame seed for bread making may reduce the incidence of wheat-related health problems such as celiac diseases (Murray,1999), confer some therapeutic effects to consumers, reduce cost and balance the amino acid contents of bread. The bread quality may generally improve. Sesame seed has been shown to possess natural antioxidants and may protect against lipid peroxidation induced by oxidative stress (Osawa *et al*., 1995).

Objective of the study

The general objective of this study is to evaluate the effect of added crushed and uncrushed sesame seed in quality characteristics of wheat bread. Specifically the study:

i. evaluated nutrient compositions of bread samples made from crushed and uncrushed.
ii. evaluated sensory characteristics of the bread samples.

Materials and methods

Materials**:** Dry sesame seeds, wheat grains and bakery ingredients, including granulated sugar, yeast, margarine and condensed milk powder. These were purchased from commercial stockers in Lafia Main Market, Nigeria.

Preparation of flour samples**:** Sesame seeds (1.5kg) and wheat grains (4kg) were washed, sun-dried (26±2^{o}C for 2days) and oven-dried (55^{o}C, 72h). Half of the sesame seeds were crushed into powder, sieved through 2mm fine sieve and re-milled into fine flour, using attrition mill (Model A1). The remaining half was used uncrushed. The wheat grains (4kg) were milled into powder in a hammer mill (Retch 5657, GmbH, Germany) and then sieved through a metal sieve of 160µm pore size to get the wheat flour. Wheat flour was blended with each of crushed and uncrushed sesame in the ratio of 9:1 and 8:2 respectively to get composite blends. The flours were sealed in polyethylene bags, put in air-tight containers and then stored at room temperature (27±2^{0}C) until used for baking.

Preparation of bread samples**:** Straight dough method was used to mix each of the wheat or composite flours with sugar (43g), yeast (9g), milk powder

(9g), water (280ml) and margarine (50g) giving dough samples with 0% (B1), 10% uncrushed (B2), 20% uncrushed (B3), 10% crushed (B4) and 20% uncrushed sesame seeds . The dough was kneaded and allowed to ferment for 2h at room temperature (26±2^{o}C), cut into 60g pieces for proofing in bread pan for another 1h. These were baked at oven temperature of 190^{o}C for 40min using standard baking method, cooled overnight and then subjected for chemical and sensory analysis the following day.

***Chemical analysis of Bread Samples*:** Proximate composition (moisture, protein, crude fat, fibre, ash and carbohydrate) of the bread samples was determined according to the method of Association of Official Analytical Chemists (AOAC, 2012).The bread samples were each milled into homogenous blend and 5g of each used for each analysis. The moisture content was recorded as the loss in weight after heating 5g of each blend in a vacuum oven at 105^{O}C for 4 hours. Macro-Kjeldahl method was used for nitrogen (N) determination, and the crude protein content calculated from the expressed, N x 6.25. Crude fat was determined as the loss in weight after exhaustive extraction of each sample (5g) with petroleum ether (boiling point 40-60^{O}C) in a soxhlet apparatus. The fat-free samples after ether extractions were digested alternately with 1.25% H_2SO_4 and 1.25% of NaOH in fume chamber. The residues were ignited at 600^{O}C for 4h and the loss in weight recorded as the crude fibre while the residual component was recorded as the ash content (a measure of the mineral content). Carbohydrate content (%) was determined by difference (subtracting the sum of moisture, crude protein, fat, fibre and ash contents from 100). The ash samples were dissolved in distilled water, and the filtrates used according to the AOAC method (2012) to determine calcium, iron, magnesium and zinc using an Atomic Absorption Spectrophotometer (AAS, Model SP9,Pychicham,U.K) while phosphorus content was determined by the phosphomolibdate method.

Sensory Analysis of bread: A 20 member untrained panelists were used to evaluate the sensory characteristics (taste, crumb color, mouth feel, flavour and overall acceptability) of the five bread samples to determine level of acceptability of crushed and uncrushed sesame seed in bread. The 100% wheat bread sample served as a positive control. Each of the bread samples was served to the panelists in duplicates in the sensory evaluation room of the College of Agriculture, Lafia, Nasarawa State, Nigeria. The room was illuminated with white fluorescence light. Panelists attended two sessions and at each session, samples (five uniform slices of bread) were served to panelists at room temperature (26±2^{OC}) in white saucers randomly coded with one-letter and two-digit numbers. Panelists were provided with water to rinse mouth between evaluations and were asked to record their appreciations on score sheets provided. The appreciations were balanced and equidistant at a 9-point hedonic scales using 1= extremely disliked, 2= very disliked, 3= moderately disliked, 4= slightly disliked, 5= neither disliked nor liked, 6= slightly liked, 7= moderately liked, 8= very liked and 9= extremely liked (Melligard *et al*., 1999**).** using a 9-point hedonic scale.

Data Analysis: Data were analyzed using analysis of variance (ANOVA) and means separated using Turkeys least significance difference (LSD) at p>0.05.

Results

Effect of Sesame Seed addition on Proximate Composition of bread samples

Table1. Proximate composition (%) of bread samples with added sesame

Treatment	Moisture	Ash	Fat	Protein	Fiber	Carbohydrate
BI	33.46^{a}	2.52^{b}	3.26^{e}	8.71e	2.88^{a}	49.2^{a}
B2	31.89^{c}	2.33^{c}	5.63^{d}	9.72^{d}	2.59^{b}	47.8^{b}
B3	30.38^{e}	6.27^{a}	10.63^{b}	11.3^{a}	2.47^{d}	44.4^{d}
B4	32.58^{d}	2.52^{b}	6.83^{c}	9.94^{c}	2.56^{c}	45.6^{c}
B5	30.57^{d}	5.55^{d}	16.41^{a}	10.16^{b}	2.56^{c}	38.5^{c}

Values are means of 3 determinations and means with the same superscript in the same column are not significantly (p<0.05) different. The treatments are breads with 0% (B1), 10% crushed (B2), 20% crushed (B3), 10% uncrushed (B4) and 20% uncrushed (B5) sesame seeds.

Table 1 shows proximate composition of the five bread samples that had different levels of crushed or whole sesame seed. The protein, fat and ash contents increased with increasing sesame seed addition. The protein content (%) ranged from 8.71 in the control sample (B1) that had no sesame to 11.3 in the sample (B3) that had 20 % crushed sesame seed. Fat content varied widely and range from 3.26% in BI, the control, to 10.33% in B3 again. Fiber content (%) was maintained within 2.47 in B3 which had 20 % uncrushed sesame seed to 2.88 in the control, B1 which had 10% uncrushed sesame seeds. However, moisture and carbohydrate content s (%) decreased with increasing sesame seed addition in the bread samples.

Effect of Sesame Seed addition on Mineral Composition of bread samples

Table 2: Effect of sesame seed addition on mineral composition of bread samples

Treatment	Zinc(mg/100g)	Iron(mg/100g)	Calcium(mg/100g)	Magnesium(mg/100g)	Phosphorus(mg/100g)
B1	2.32^{d}	1.15^{d}	0.12^{e}	0.31^{d}	146.8^{e}
B2	2.57^{b}	1.92^{b}	0.24^{c}	0.32^{c}	182.8^{d}
B3	2.59^{a}	2.29^{a}	0.29^{b}	0.41^{b}	216.4^{c}
B4	2.28^{e}	1.77^{c}	0.17^{d}	0.27^{e}	234.8^{b}
B5	2.47^{c}	1.92^{b}	0.38^{a}	0.42^{a}	275.4^{a}

Values are means of 3 determinations and means with the same superscript in the same column are not significantly ($p<0.05$) different. The treatments are breads with 0% (B1), 10% crushed (B2), 20% crushed (B3), 10% uncrushed (B4) and 20% uncrushed (B5) sesame seeds.

Table 2 shows mineral composition of the bread samples. The bread samples were rich in zinc (2.32-2.47mg/100g) and iron (1.15-2.2mg/100g) but relatively low in calcium (0.12-0.39mg/100g), magnesium (0.31-0.42mg/100g and phosphorus (0.147-0.275mg/100g). The levels of these minerals in the bread samples increased with increasing addition of sesame in the zinc and iron increased respectively from 2.32 and 1.15 in the control with 100% wheat flour (H1) to 2.47 and 1.92mg/100g in the bread sample with 20% crushed sesame (B5). Similarly calcium increased from 0.12 and magnesium from 0.31 in B1 (the control with no sesame) to 0.38 and 0.42mg/100g in the bread sample with 20% crushed sesame seed (B5) respectively. Phosphorus content increased in the same order.

Effect of Sesame Seed addition on Vitamin Content of bread samples

Table 3: Effect of sesame seed addition on vitamin composition of bread samples

Vitamins	B1	B2	B3	B4	B5
Thiamin	0.66^{d}	0.68^{c}	0.69^{a}	0.66^{d}	0.69^{b}
Riboflavin	0.54^{e}	0.57^{c}	0.58^{b}	0.55^{d}	0.59^{a}
Niacin	0.33^{d}	0.36^{b}	0.36^{a}	0.35^{c}	0.35^{c}

Values are means of 3 determinations and means with the same superscript in the same column are not significantly ($p<0.05$) different. The treatments are breads with 0% (B1), 10% crushed (B2), 20% crushed (B3), 10% uncrushed (B4) and 20% uncrushed (B5) sesame seeds.

Table 3 shows Vitamin contents of the bread samples. The vitamin contents (mg/100g) ranged from 0.66 to

0.66 for thiamin, 0.54 to 0.59 for riboflavin and 0.33 to 0.36 for niacin. The bread samples were poor in these vitamins as their range in these breads was low. There was however significant ($p>0.05$) increases in vitamin contents of the bread as the amount of sesame seed in the samples increased.

Effect of Sesame Seed addition on Phytochemical Composition of bread samples

Table 4: Effect of sesame seed addition on phytochemical composition of bread samples

Phytochemical Composition(mg/100g)	B1	B2	B3	B4	B5
Phenol	0.37[d]	0.51[c]	0.62[a]	0.57[b]	0.57[b]
Anthocyanin	0.76[d]	0.81[c]	0.85[a]	0.83[b]	0.85[a]

Values are means of 3 determinations and means with the same superscript in the same column are not significantly ($p<0.05$) different. The treatments are breads with 0% (B1), 10% crushed (B2), 20% crushed (B3), 10% uncrushed (B4) and 20% uncrushed (B5) sesame seeds.

Table 4 shows Phytochemical contents of the bread samples. The total phenol (mg/100g) and anthocyanin (mg/100g) content increased significantly ($p > 0.05$) with increasing addition of sesame in the bread samples. Total phenol (mg/100g) contents ranged from 0.368 to 0.57 while the anthocyanin (mg/100g) contents ranged from 0.78 to 0.85 in the brad samples. Total phenol and anthocyanin contents were highest in bread sample with 20% crushed sesame seed but lowest in the control bread sample. The levels of these phytochemicals in the bread samples were relatively low to constitute any antnutritional factor. At these ranges in the bread samples, they could confer beneficial effects to consumers.

Effect of Sesame Seed addition on Sensory attributes of bread samples

Table 5: Effect of sesame seed addition on sensory scores of bread samples

Bread Samples	Taste	Crumb Colour	Texture (Mouth feel)	Flavour	Overall Acceptability
B1	6.50±244^{C}	7.00±1.12^{b}	6.00±2.22^{e}	6.05±2.0^{e}	6.75±1.9^{a}
B2	7.00±1.69^{b}	6.95±1.70^{c}	7.20±1.67^{a}	6.85±2.0^{a}	6.60±1.8^{b}
B3	6.15±2.30^{e}	5.95±1.9^{e}	6.30±1.6^{c}	6.55±1.6^{c}	6.55±1.5^{c}
B4	7.70±1.56^{a}	7.20±1.5^{a}	7.10±1.3^{b}	6.60±1.8^{b}	6.35±2.2^{d}
B5	6.35±2.52^{d}	6.55±2.04^{d}	6.28±1.8^{d}	6.20±2.5^{d}	6.35±2.2^{d}

Values are means of 3 determinations and means with the same superscript in the same column are not significantly (p<0.05) different. The treatments are breads with 0% (B1), 10% crushed (B2), 20% crushed (B3), 10% uncrushed (B4) and 20% uncrushed (B5) sesame seeds.

Table 5 shows the sensory scores of bread sample prepared with different level of sesame. The sensory scores for the entire attribute – taste, crumb colour, mouth feel, flavour and over all acceptability –ranged from 6.05 to 7.70 on a 9-point hedonic scale. All the experimental bread samples were generally acceptable by the assessors.

However, the control bread was significantly (p > 0.05) most acceptable among the five bread samples. Among the experimental breads, B2 (with 10 % uncrushed sesame seeds) and B4 (with 10 % crushed sesame seeds) had better sensory attributes than those with 20 % sesame addition (B3 and B4). However, B2 with crushed sesame was more acceptable than B4 with uncrushed sesame.

Discussion

The increases in protein, fat, and ash contents in the bread samples that had sesame was as a result of high content of these nutrients in the sesame seeds. Protein is needed regularly in the diet for growth, repair and maintenance of worn-out tissues. High ash contents in the sesame supplemented bread samples implies high contents of minerals and this is good for proper physiological functioning of the body. Sesame is known to contain high content of poly unsaturated fatty acids (PUFA) which are very essential to the internal organs and their functioning (Emmanuel-Ikpeme *et al.*, 2012)).

The improved mineral contents in bread samples that had added sesame implies that sesame could be effectively used to improve mineral contents of bread for higher nutritional value. Minerals are known to regulate nutrients in the body. Zinc is needed for normal growth, development, reproduction and immunity. It aids in a healthy appetite, perception of taste and capacity for night vision. It acts as a coenzyme, working with many hormones. Calcium aids in strong bones and helps to maintain muscle contraction and relaxation, blood clotting, synaptic transmission and absorption of vitamin B12Magnesium is known to decrease blood pressure. Iron is needed in hemoglobin formation (Latunde-Data, 1990). Most of these minerals are also co-enzymes in certain biochemical processes in the body (Latunde-Data, 1990).

Thus, substituting part of the wheat for sesame is vital to improve the vitamin contents in the bread samples. Vitamins are generally physiological regulatory nutrients. They are needed in small amount but regularly in a diet for the good health of consumer. They yield no energy directly but may contribute to energy yielding chemical reactions in the body and promote growth and development (Murray, 1998).Thiamin, riboflavin and niacin play key roles as co-enzymes in energy yielding processes. They help in metabolizing carbohydrate, fats and oil.

Phenol and anthocyanin are therapeutic and are non-nutritive ingredients of many herbs, fruits and vegetables where they act as active ingredients. Phenols are one of the non-nutritive dietary components that have been associated with inhibition of cancer, atherosclerosis and in ameliorating age-related diseases (Chang *et al*, 2002).Phenols generally inhibit autoxidation of unsaturated lipids and prevent formation of oxidized low density lipoprotein (LDL) which causes cancer-related diseases (Fang *et al,* 2002). Anthocyanins are also known to inhibit LDL oxidation (Fang *etal,* 2002).

Both the control (B1) and experimental (B2 – B5) breads were highly acceptable to the Panelists. However, the control bread was most acceptable than the experimental breads; and among the experimental breads, bread samples wit 10% crushed and uncrushed sesame seeds were more acceptable than those with 20% sesame addition. Thus, consumer acceptability of sesame in bread is optimum at less than 20% sesame addition.

Conclusion

Sesame can be substituted for part of wheat to produce bread of higher quality and acceptable to the consumer. This could reduce cost of the bread, add value to sesame and provide healthier bread to Nigerians.

Recommendation

i. Bakery industries in Nigeria should be encouraged by the Government to incorporate sesame in bakery products for consumers to get its health benefit.

ii. Nigerian Government should encourage farmers to farm more sesame in the country.

iii. There should also be public campaign by Government and non-government agencies to create awareness to consumers to patronize sesame-fortified foods for its health benefits.

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