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Quality Evaluation of Bread Enriched With Mushroom Powder

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Abstract:*Bread samples were produced with 5 % and 10 % mushroom powder separately and bread without mushroom served as the control. The bread samples were analysed for functional properties, nutrient composition, and sensory qualities. The samples were stored for 6 days (28 ^{o}C ± 2) and the total fungi and total bacteria of the fresh samples were determined andduring storage at every 48 h. Data generated was subjected to analysis of variance ($P < 0.05$) while means were separated by Duncan multiple range tests. Results showed that there was no significant difference in the specific volume and bread weight of the mushroom samples and the control. The protein, ash, fat, crude fibre and moisture content increased while carbohydrate decrease with increased percentage of mushroom. The control had the lowest moisture (16.50 %), crude protein (9.28 %), crude fat (14.70%), crude fibre (0.89) and ash content (1.75 %). There was no bacterial growth in the samples at the end of the experiment while total fungi count was 2.0×10^2 for 5 % containing mushroom bread and 8.0×10^2 for sample containing 10 % mushroom. There was no detectable fungal growth in the control. The mushroom bread samples were not significantly different in colour, aroma and texture from the control but were significantly different in taste and overall acceptability. Addition of mushroom to bread for the purpose of enrichment and with acceptable sensory quality and meaningful shelf life could be achieved at a level not exceeding 10 %.*

Key words: *Bread Mushroom powderQuality Baking*

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I. Introduction

According to Wani et al. (2010) mushroom are important constituent of minor forest produce that grow on most abundant biomolecule of the biosphere i.e. cellulose. Presently mushrooms are regarded as macro-fungus with a distinctive fruiting body which can be either epigeous or hypogenous and large enough to be seen with the naked eyes to be picked up by hand (Chang and Miles, 1992). Only fruiting body of the mushroom can be seen as the rest of the mushrooms remain underground as mycelium. Mushrooms offer tremendous applications as they can be used as food and medicines besides their key ecological roles. They represent one of the world's greatest untapped resources of nutrition and palatable food of the future. Mushrooms are considered as a delicacy with high nutritional and functional value and they are also accepted as nutraceutical foods. They are of considerable interest because of their organoleptic merit, medicinal properties and economic significance.

Edible mushrooms are commonly used in home cooking and in catering (Kubiak, 2001). They can be successfully used as appetizers in marinated form and also as an ingredient in soups, sauces, salad, stuffing and meat dishes (Achremowicz et al, 1983). Mushrooms contain many minerals salts and some vitamins particularly of the B group (Breene, 1990, Vetter 1994, Mattila et al, 2001). Mushroom are frequently regarded as therapeutic food having anti-carcinogenic, anticholesterolaemic and antiviral properties and also prophylactic properties with regards to coronary heart disease and hypertension (Bobek et al, 1995, Bobek and Galbary 1999, Mattila et al, 2000). Mushrooms have also been found to be effective against stress, insomnia, asthma, allergies and diabetes (Bahl, 1983).

Bread is a food product that is universally accepted as a convenient product form of food that has desirability to all population rich and poor, rural and urban (Malomo et al, 2012). Bread is a cereal product that is naturally low in protein and nutritionally not a balanced diet because it is low in lysine, an essential amino acid (Giami*et al.,* 2003, Agu*et al.,* 2010. White bread lacks vitamin B which helps the body cells to convert carbohydrates into the required energy. Also, lack of fiber in white bread exposes one to constipation problems due to slow intestinal food movement. However, nutritional content of bread will be increased by addition of mushroom with its numerous benefits (Matilla, 2001, Barros et al., 2008).

II. Materials and methods

Collection of raw materials

Edible mushroom (*Pleurotusostreatus)* was obtained from Babcock university mushroom farm in Nigeria. Other materials like margarine, yeast, salt, granulated sugar, all-purpose flour were obtained from Ilishan-Remo market. While the baking equipment were provided by the Department of Nutrition and Dietetics in the university.

Preparation of mushroom powder

The fresh edible mushroom was processed into mushroom powder by using the method described by Okeke et al., 2003. The mushroom was washed properly to remove dirt and was cut into smaller pieces. It was blanched in hot water at 32 ^{o}C for three minutes which contains 3 % salt. The water was drained and the mushroom was dried in a hot air oven which was maintained at 105 ^{o}C for 3 hours. The dried mushroom was then blended into a powdery form and kept in transparent polythene bag until it was required. The processing procedure is as presented in Fig. 1.

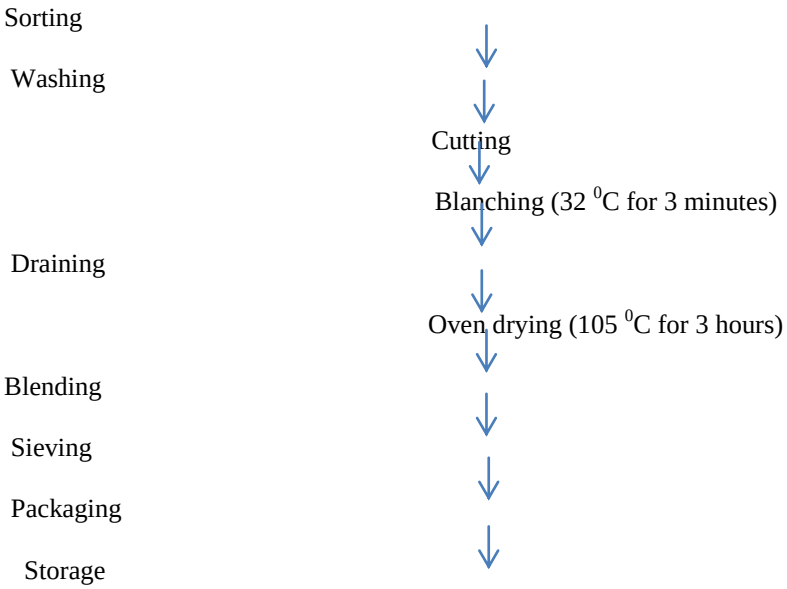

Fig. 1: Flow chart for the preparation of mushroom powder

Preparation of mushroom bread

The procedure for production of bread samples is presented in Fig. 2. Bread samples were prepared using the straight dough method as described by Ceserani*et al (*1995). The recipe for each bread sample is as follow;
Sample A (control) was 200 g of flour, 66.4 g of butter, 3.6 g of salt, 62 ml of water and 1.6 g of yeast.
Sample B (5 % mushroom) consisted of 190 g of flour, 63.08 g of butter, 3.42 g of salt, 1.52 g of yeast, 62 ml of water and 10 g of mushroom powder while,
Sample C (10 % mushroom) contained 180 g of flour, 59.79 g of butter, 3.24 g of salt, 1.44 g of yeast, 62 ml of water and 20 g of mushroom.

Each appropriately weighed flour and other ingredients were thoroughly mixed to produce dough. The dough obtained after mixing was cut into uniform sizes by weighing. Each one was manually kneaded, molded into bread rolland transferred to buttered tray which was placed in a cabinet to proof. The leavened dough was carefully transferred to the thermostatically controlled baking oven and baking was done at 230 ^{0}C for 20 minutes. The mushroom bread produced were cooled at ambient temperature and packaged in polythene bags for analysis.

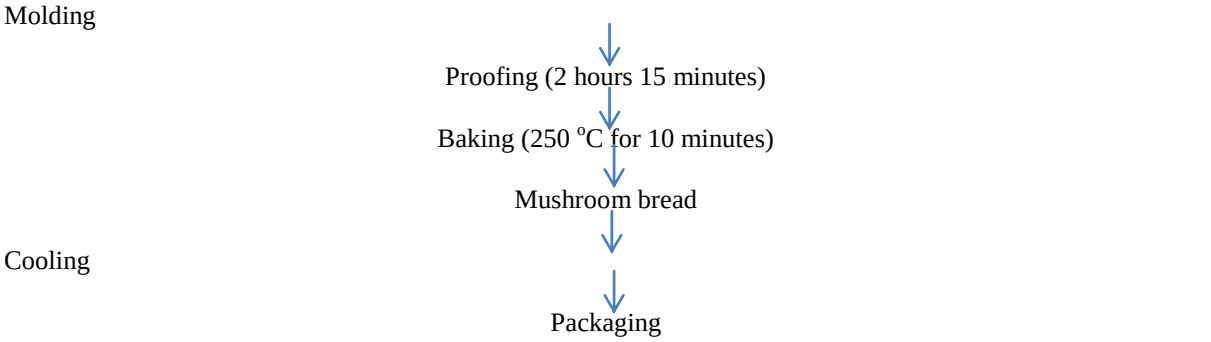

Fig. 2: Flowchart for the production of mushroom bread

Determination of functional properties

Determination of the bread volume

Loaf volume was determined using small seeds displacement method (Ceserani, 1995). A container was filled with millet seeds, levelled with ruler and the weight of the millet seed that filled the container was determined. Then half of the millet was poured out and the sample placed on top of the millet seed after which the remaining millet seed was poured to cover up the sample and was levelled. The remaining millet which is the loaf volume was measured in a graduated cylinder. The procedure was carried out for the three samples in duplicate.

Determination of loaf weight

The loaf weight was determined by measuring the weight of the loaf sample in a calibrated weighing balance and reading was taken in grams.

Determination of specific volume

The specific volumewas determined from the ratio of loaf volume and loaf weight (Shittu*et al.,* 2007).
Calculation:

Specific volume (cm^3/g) = Loaf volume
Loaf weight

Nutrient content of mushroom bread

The moisture content, crude protein, ash content, crude fibre, crude fat and carbohydrate of the mushroom bread with the control sample were determined. Samples were analyzed according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C., 2015).

Moisture content

Five grams of each of the samples was weighed into previously weighed petri dishes. The petri dishes plus samples were then transferred in the oven set at 105 ^{0}C for 1 hour at the end of which they were removed and placed in the desiccator to cool for 20 minutes this was repeated until constant weight was obtained. The weight of the samples was recorded. Percentage moisture content was calculated from the formula below:

% Moisture = (final weight of crucible) – (Initial weight of crucible + sample)× 100
Weight of sample

Total ash

A clean empty dry crucible was weighed on analytical balance**.** It was tarred to zero and 2g of sample was added. It was then kept in the furnace at 550 °C for 4 hours. The crucible was removed and placed into the desiccator for cooling. After cooling in the desiccator, the weight of the sample was taken and recorded. The percentage ash was calculated from the formula below:

% Ash = Final weight of crucible – Initial weight of crucible × 100
Weight of sample

Crude fat

One gram of samples was each weighed in a filter paper and placed in a thimble and labelled. The thimble was then placed in the extractor. An already weighed solvent flask was connected beneath the apparatus after 50 ml of petroleum ether was added into the solvent flask. After the thimble and solvent flask was properly fixed into a fat extraction machine, it was timed to extract for 6 hours. After the extraction was completed, the thimble was removed and the remaining ether was reclaimed using the apparatus. The flask was then dried at 105 ^{o}C for 30 minutes. It was then cooled in the desiccator, weighed and recorded.

Crude protein

Digestion: Each finely ground dried sample (0.5 grams) was weighed carefully into the Kjeldahl digestion tubes and it was ensured that all the sample materials get to the bottom of the tubes. One Kjeldahl catalyst tablet was added to each of the tubes followed by addition of 12 to 15ml of Conc. H_2SO_4. They were set in the appropriate hole of digestion block heaters in a fume cupboard. The digestion was left for 1 hour 15 minutes after which a clear colourless solution remained in the tube. The digest was left in the fume cupboard for cooling and it was diluted with some quantities of distilled water to lower the high concentration of the acid.

Distillation: Ten millilitre of a liqout digested sample was pipetted in a volumetric flask from Kjeldhal flask of distillation unit. Twenty millilitreof 40%NaOH was added to make the contents alkaline and it was then washed with a small quantity of distilled water and the end was closed with a pinch cock. The funnel was sealed with a little amount of distilled water to avoid escape of ammonia. The distilled content of distillation unit was steamed by boiling with water in a round bottom flask connected to the distillation unit. The released ammonia was then collected in a 25 ml sulfuric acid in a conical flask to ensure all nitrogen in the form of ammonia was distilled. The conical flask was removed withthe distillate after washing the tip of the condenser with a few ml of distilled water.

Titration: The green coloured solution obtained was then titrated against 0.1N H_2SO_4 contained in 50 ml burette. At the end point, the green colour turned to wine colour which indicated that all the Nitrogen trapped as Ammonium Borate $[(NH_4)_2BO_3]$ have been removed as Ammonium chloride $[(NH_4)_2SO_4]$. The percentage nitrogen in this analysis was calculated using:

$$\% \text{ Nitrogen} = \frac{(\text{Volume of acid} - \text{Blank}) \times 14.01 \times 100 \times \text{Normality of acid}}{\text{Weight of sample}} \times 1000$$

Crude fibre

The fibre cap was weighed and recorded. 1 gram of each sample was weighed and poured into the fibre cap and dipped into the solution H_2SO_4 (1.25%). It was then placed on the hot plate and digested for 35 minutes. After this, it was removed and washed with hot distilled water. The procedure was repeated placing the fibre cap into the 1.25% KOH for another 35 minutes before it was removed and washed with hot water. It was then placed in the oven for 3-4 hours to dry. An empty crucible was weighed and recorded. The weight of the fibre cap + dry sample was taken. The dry cap was put into the crucible and placed into the furnace for about I hour. After this, it was removed and placed into the desiccator for cooling. The weight of the samples were then taken and recorded. The fibre level was determined by the formula:

$$\% \text{ Fibre} = \frac{W3 - (W5 - W4) - (0.9987 \times \text{Wt of empty crucible}) - 0.002 \times 100}{\text{Weight of the sample}}$$

Carbohydrate content

Carbohydrate content was determined by difference. This was done by subtracting sum of (Moisture % + % Crude Protein + % Ether Extract + %Crude Fibre + % Ash) from 100 i.e. (100 – (% M + % CP + % EE + % CF + % Ash).

Shelf life study

Bread samples were packaged in polythene bag and sealed. The samples were stored at ambient temperature of 27± 2 ^{o}C for six days. Samples were drawn every 48 h for determination of total bacteria and fungi.

Sensory evaluation

The bread samples which were control (0% mushroom), bread containing 5 % mushroom and bread with 10 % mushroom were assessed by a ten- membered untrained panel which consisted of lecturers and

students of Department of Nutrition and Dietetics. The samples were analyzed for colour, aroma, texture, taste and overall acceptability. The score was based on a hedonic scale ranging- from 1 representing dislike extremely to 9 representing like extremely (Lakshmi, 2015).

Statistical analysis:

Data obtained were subjected to one- way analysis of variance (ANOVA) and means were separated using the Duncan multiple tests (SPSS 20.0).

III. Results and discussion

Results

The bread samples are presented in Plate 1. They are not so different in size, the colour grew darker from the control to bread with 10 % mushroom. The samples were of uniform crumb structure though there was loosening of structure from the control to bread with 10 % mushroom (Plate 2).

Plate 1: Mushroom bread samples

0 % Mushroom 5 % Mushroom 10 % Mushroom
Sample A: 0% Mushroom
Sample B: 5% Mushroom
Sample C: 10% Mushroom

Plate 2: Crumb structure of mushroom bread samples

0% Mushroom 5% Mushroom 10% Mushroom
Sample A: 0% Mushroom
Sample B: 5% Mushroom
Sample C: 10% Mushroom

Functional properties of the mushroom bread sample

Functional properties of the mushroom samples are as presented in Table 1. The weight of the bread samples ranged from 77.71 – 78.70. The specific volume was 1.550±0.09 for the plain bread while the mushroom bread samples had the specific volume of 1.465±0.03 and 1.530±0.01 for bread containing 5 % and 10 % mushroom respectively.

Table 1: Functional properties of mushroom bread samples

Parameters	Control	Sample B	Sample C
Specific volume	1.550^{a}±0.09	1.465^{a}±0.03	1.530^{a}±0.01
Bread weight	77.85	78.70	77.71

Control: 0 % mushroom
Sample B: 5 % mushroom
Sample C: 10 % mushroom

Nutrient composition of the mushroom bread samples

Nutrient composition of the mushroom bread samples is as presented in Table 2. The values for the bread samples ranged between 16.50 -17.03 % for the moisture content, 9.28 -10.33 % for crude protein, 14.70 -15.90 % for crude fat, 0.89 -1.80 % for crude fibre, 1.75 -2.05 % for ash content and 52.34 -56.88 % for the carbohydrate content.

Table 2: Nutrient composition of mushroom bread samples

Nutrients	Sample A	Sample B	Sample C
Moisture content (%)	16.50	16.97	17.03
Crude protein (%)	9.28	9.54	10.33
Crude fat (%)	14.70	15.60	15.90
Crude fibre (%)	0.89	1.60	1.80
Ash content (%)	1.75	1.90	2.05
Carbohydrate (%)	56.88	52.34	52.89

Sample A: 0% Mushroom
Sample B: 5% Mushroom
Sample C: 10% Mushroom

Shelf life of bread samples

The results (Table 3) showed that there was no fungi count in the control sample through the period of storage while growth of 2.0×10^{2} was recorded in the sample with 5 % and 10 % mushroom powder on the 4^{th} and 6^{th} day respectively. There was no bacteria growth in any of the samples through the period of storage.

Table 3: Microbiological quality of the mushroom bread samples

	Days	Sample A	Sample B	Sample C
Total fungi (cfu/gm)	0	-	-	-
	2	-	-	-
	4	-	-	2.0×10^{2}
	6	-	2.0×10^{2}	8.0×10^{2}
Total bacteria (cfu/gm)	0	-	-	-
	2	-	-	-
	4	-	-	-
	6	-	-	-

Sample A: 0% mushroom
Sample B: 5% mushroom
Sample C: 10% Mushroom

4.1.4 Sensory quality of the mushroom bread

Bread with 0 % mushroom received high ranking for all the parameters determined. The overall acceptability of the mushroom bread samples was 7.00±1.33 and 5.60±2.591 for bread with 5 % and 10 % mushroom respectively while the value for white bread sample was 7.40±1.64.

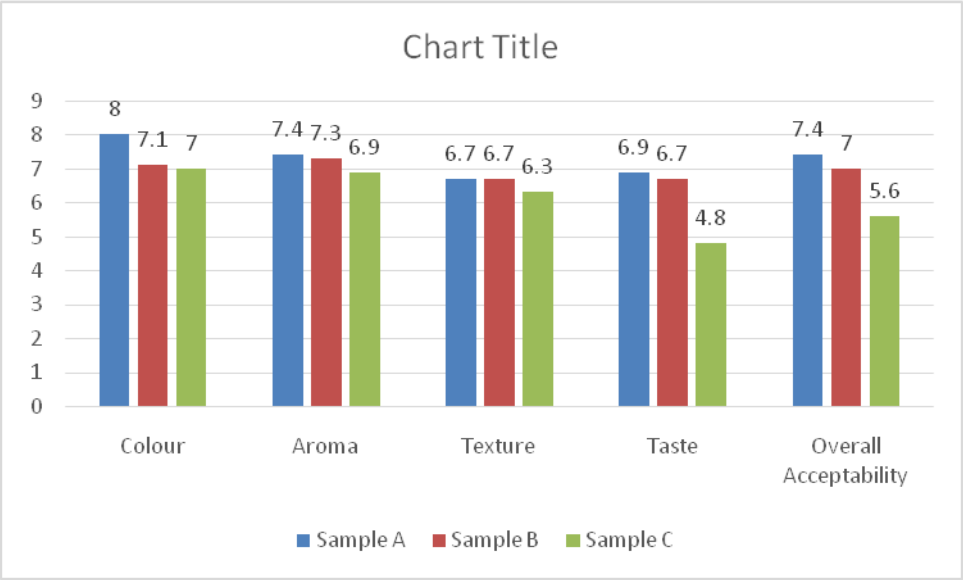

Figure 4: Sensory quality of the mushroom bread.

Sample A: 0% Mushroom
Sample B: 5% Mushroom
Sample C: 10% Mushroom

IV. Discussion

The crust colour of the bread samples was similar while the colour of the bread crumb became deeper from the control to the bread with 10 % mushroom powder. There was no noticeable difference in the crumb structure only that there was progressive loosening of the crumb as the percentage of mushroom powder increased. The results of the functional properties of the bread samples showed that the bread samples produced using mushroom powder were not significantly different in specific volume and bread weight from the plain bread (control). Specific volume and weight of the control and mushroom samples being 1.530± 0.01 - 1.550± 0.09 and 77.71 – 78.70. This observations differ partly from the report of Okafor et al. (2012) who reported decrease in loaf volume, crumb grain and loaf quality with increase in mushroom supplementation.

Nutrient composition of the bread samples was affected with increase in the percentage of mushroom added. There was an increase in the protein, fat, ash and crude fibre of the samples containing mushroom with the 10 % sample having the highest values. The protein, ash and crude fibre content were comparable to what was reported by Okafor et al. (2012) for bread supplemented with mushroom, Salehi et al. (2016) for sponge cake supplemented with mushroom and Azeez et al. (2018) for bread from blend of cassava and mushroom. However, these earlier studies reported higher content of carbohydrate than what was found in this work while in this study the fat content was very much higher than what wasearlier reported. These differences may be partly due to difference in the recipe used for the bread production. Low moisture content recorded for the control bread is similar to what was observed by Azeez et al. (2018) and Mahedy et al. (2012) which was largely due to the difference in composition of the samples due to addition of mushroom.

Results of microbiological stability of the bread sampleswhich also constitute the shelf life study in this research showedthat there was no bacteria growth in any of the samples through the period of storage while fungal growth was recorded in the sample containing 10 % mushroom on the 4th day and in the 5 % mushroom bread sample on the 6th day. Microbial growth recoded in these samples may likely be due to higher moisture content of the mushroom containing samples compared to the control.

The mushroom samples were not significantly different from the control in colour, aroma and texture. The mean range for colour, aroma and texture being 7.00±1.633- 8.00± 0.943, 6.90± 1.524 - 7.40± 1.506 and for texture 6.70± 1.947 - 6.30 ± 2.263 respectively. However mushroom sample containing 10 % mushroom was significantly different in taste and overall acceptability. This finding is supported by the report of Singh et al (2016) for biscuit containing mushroom and Okafor et al. (2012) who reported no significant difference between the control and 5% supplementation with mushroom. However, the result of this study differ from what was reported by Okafor et al. (2012) in that 10 % containing bread sample differ in taste and acceptability. Also this finding is partly supported by the report of Azeez et al. (2018) who reported no significant difference in the flavour and acceptability of bread from cassava flour supplemented with mushroom.

V. Conclusion

Inclusion of mushroom in bread did not affect the specific volume and bread weight. The addition of mushroom increased the protein content, ash content, fibre content, moisture content and fat content of bread. However, the shelf life of bread was shortened by the addition of mushroom. Bread samples containing mushroom are not significantly different from plain bread in terms of colour, aroma and texture while the added mushroom had effect on the taste and overall acceptability.

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