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QUALITY CHARACTERISTICS OF COOKIES PRODUCED FROM COMPOSITE FLOURS OF WHEAT AND MUSHROOM

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ABSTRACT

The use of mushroom flour (MF) substitution in wheat flour (WF) from 10 to 30% each, for the production of cookies was investigated. The proximate analysis, sensory evaluation and microbiological examination of the cookies samples were determined. Fresh mushroom samples were sorted and dried at 55^0C for 2hrs to produce four blends with wheat flour baked produce cookies The crude protein, crude fibre, and ash content of the mushroom supplemented cookies (MSCs) increased with progressive increase in the proportion of mushroom floor, with the 30% MSCs having higher values of 14.05%; 4.22% and 5.5% respectively, while lowest values we recorded for the whole wheat cookies (WWC). The carbohydrate content was observed to decrease with corresponding increase in the percentage of mushroom flour in MSCs. The sensory evaluation shows that no significant differences were observed between the WWC and the 10% MSCs, in the sensory attributes of aroma, texture, taste and overall acceptability ($p<0.05$). The crude protein of mushroom supplemented cookies and WWC ranges between 12.5 to 14.05% with the mushroom supplemented cookies (MSCs) having the highest value. The ash content increased with progressive increase in the proportion of mushroom flour, the highest value (5.50) was recorded for the 30% MSCs.There were significant differences ($p<0.05$) between WWCs and MSCs up to 10% supplementation in all the sensory attributes tested; aroma, texture and overall acceptability. The data obtained from the study clearly show the nutritional potentials of the nut as alternative food ingredient for protein supplementation and its reliability as a good source of amino acids for school children and adults.

Keywords: Mushroom flour, proximate analysis, sensory evaluation, total plate count, quality, wheat.

INTRODUCTION

Cookies are convenient snacks product dried to a very low moisture content taken among young people and adult to provide energy [1].This food is made from unleavened dough [2].It is produced from a mixture of flour and water which may contain fat, sugar and other ingredients mixed together into dough which is rested for a period and passed between rollers to make a sheet [3]. It provides an excellent means of improving the nutritional quantity of foods through incorporation of less expensive high quality protein, minerals, vitamins and has been employed in food product enrichment [4].

The consumption of which is steady and increasing in Nigeria. It is however, relatively expensive, being made from imported wheat that is not cultivated in the tropics for climatic reasons. Wheat importation represents an immense drain on the economy while also suppressing and displacing indigenous cereals, with a resultant detrimental effect on agricultural and technological development. The need for strategic development and use of inexpensive local resources in the production of popular foods such as cookies has been recognized by organizations such as the Food and Agricultural Organization (FAO), the International Institute for Tropical Agriculture (IITA), Nigeria and the Federal Institute for

Industrial Research, Oshodi (FIIRO), Nigeria. Mushrooms shall be used as a substitute to wheat in varying ratio for cookies production as a local alternative for cookies production. Mushrooms are non-green, edible fungi. They are a large heterogeneous group having various shapes, sizes, appearance and edibility. Mushrooms are a good source of high quality protein which varies between 8.1-43.02% on dry weight basis depending on the specie [5]. They are good source of non-starchy carbohydrates, dietary fiber, protein, mineral and vitamins [6]. Mushrooms are a seasonal and highly perishable crop and contain about 90 %(w.b.) moisture.

Mushrooms have been part of man's diet for centuries. Production and consumption of button mushroom have registered tremendous increase in the recent past. However, they contain large quantity of water (approximately 90 per cent) and therefore suffer considerable weight loss during transportation and storage. This in the turn causes serious economic losses, due to reduction in weight and quality. Further, in the peak periods of production, distress sales are becoming increasingly common due to its poor shelf life. Veil opening, browning, loss of moisture and texture are some common problems of mushroom processing which result in reduced market value and acceptability. The objectives of this study are (i) to determine the acceptability of mushroom as a substitute for cookies based on sensory attributes,(ii) to determine the proximate composition and microbiological qualities of cookies produced from varying substitutions of mushroom in wheat flour.

MATERIALS AND METHOD

Materials

The fresh mushroom (Pleurotus plumonarius) obtained from a commercial mushroom grower in Lagos while wheat flour(Honeywell),baking fat(margarine),granulated sugar, eggs, salt, baking powder were purchased from local market in Lagos, Nigeria. They use taken to the laboratory for immediate use and processing. All the equipment used were from Food Technology Department, Yaba College of Technology, Lagos. The chemicals were of analytical grade and purchased from Sigma of BDH Company.

Processing of Mushroom into flour

The fresh mushroom samples were sorted and graded according to size by hand trimmed using a stainless steel knife and cleaned with a soft brush. They were separated into caps and stalk and cut into uniform sizes of about 5cm diameter and 4cm long for caps and stalk respectively. The caps and stalk were dried separately as the caps dries faster than the stalk. These samples were then washed with soft bush in 0.1% sodium metabisulphite solutions to prevent browning. It was then dried in a cross flow force drought oven (Gallenkamp, model OV–160) at 55^{o}C for 2hrs to obtain 5% moisture content. The dried mushroom was milled using a milling machine (PC 4021/Britain). The flour obtain was sieved using 0.25mm sieve (Model BS 410). The Flow chart is down in Figure 1

Production of Composite

The recipe used to produce the cookies is shown in Table 1. Four blends were obtained. The fat was creamed with sugar until fluffy, other dry ingredients were added, then liquid ingredients. Water (5mls) was added to obtain the desired dough and the dough was vigorously kneaded with a dough mixer for 30 minutes [3]. The dough was then placed on a flat clean table and kneaded for 5mm to obtain the required thickness. It was cut into

and shapes using a manual cutter. The cut doughs were arranged on trays smeared with margarine and baked in oven at 200^{o}C for 20mms. The hot baked cookies were allowed to cool for 15mm and then packaged in cellophane.

Proximate analysis of cookies

The proximate composition of the Mushroom Supplemented cookies (MSCs) and whole wheat cookies (WWCs) samples were analyzed using [7]. The samples were analyzed for moisture, ash, crude fibre, crude fat and carbohydrate (by difference). Crude protein content was determined by Micro Kjeldahl method [8]

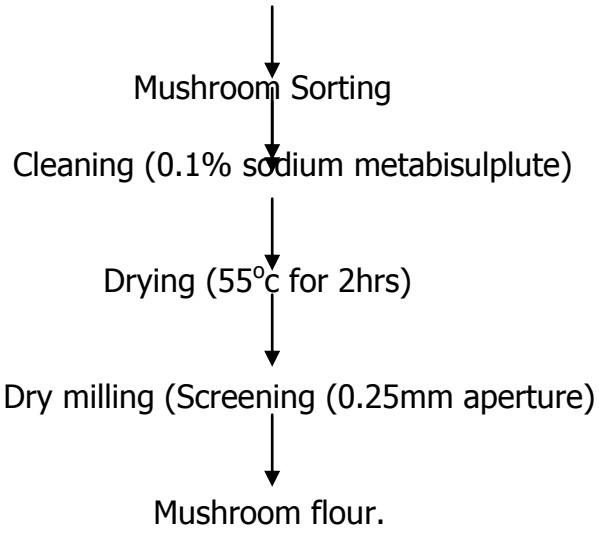

Figure 1: Flow chart for the production of Mushroom flour.

Table 1: Recipe for the production of cookies from Mushroom and wheat flour

Ingredients	**cookies blends (g)**			
	1	2	3	4
Wheat flour	100	10	20	30
Mushroom flour	-	90	80	70
Margarine (baking fat)	40	40	40	40
Granulated Sugar	30	30	30	30
Baking Powder	2	2	2	2
Egg Colour	0.3	0.3	0.3	0.3

Sensory evaluation of cookies

The cookies obtained from each blend was allowed to cool and placed into clean plates**.** A total of twenty semi-trained panelist drawn from staff and students of the Department of Food Technology, Yaba College of college of Technology, Lagos were used for evaluation. The parameters evaluated include taste, colour, aroma, texture grittiness and overall acceptability using a 9 point Hedonic scale with 1 representing dislike extremely and 9 like extremely [9]. Each panelist was provided with distilled water with which to rinse his or her mouth after tasting each sample. Analysis of variance (ANOVA) was performed on the data to determine differences among treatment. Duncan multiple range test was used to separate means where significant differences existed [10].

Microbiological Examination

The populations of the various groups of micro-organisms were determined by the procedures described by [11]. Nutrient agar and MacConkey agar were used for total aerobic bacterial and coliform count respectively, while yeast and mould population were determined using potato dextrose agar (PDA).

RESULTS AND DISCUSSION

Data on the proximate composition of wheat-mushroom cookies are presented in table 2. The proximate composition result showed that protein, fat and ash increased as the proportion of mushroom flour increased ranging from 12.15-14.05%, 5.44-6.85% and 2.49-5.50% respectively (Table 2). Also, the same trend was observed for crude fibre. This indicates that supplementing wheat flour with mushroom flour would greatly improve the protein nutritional quality of cookies. This could obviously be due to the significant quantity of protein in mushroom [5, 12, 13]. The high protein content in the wheat-mushroom supplemented food would be of nutritional importance in most developing countries like Nigeria where many people can hardly afford high proteinous foods because of their high cost. This similar observation was made in a research study by [14, 15] who showed an increase in the protein content with corresponding increase in the proportion of breadfruit flour supplementation in biscuit production from wheat- breadfruit flour blends, hence the use of mushroom to raise the protein content to more than 12% as compared with cookies made from only from wheat flour. The combination has been found more nutritious than wheat flour alone because mushroom flour is richer than wheat flour in essential amino acids.

A decrease was observed in the level of carbohydrate from 65.62%-60.13% as well as the moisture content of fortified samples from 10.83-9.25% as the proportion of mushroom flour increased (Table 2). The decrease in moisture level with increase in level of substitution might serve as an indication of increasing storage stability. This result indicates that the aim of fortification was to increase the protein content while producing a more shelf stable product due its lower moisture content. These findings were in agreement with the work of [14, 15]. The carbohydrate content decreased with increase proportion of the mushroom flour supporting the claims of [14, 15]. The ash and fat content of the mushroom supplemented wheat flour were noted to assume the same trend as the protein content. The highest fat and ash content of 6.85% and 5.50%were recorded for the 30%. Mushrooms have been reported to contain appreciable amount of minerals and fat [5, 12, 13].

The mean sensory scores obtained for the mushroom supplemented cookies (MSCs) and whole wheat cookies (WWCs) ranges between 5.2 to 8.7(Table 3). The analysis of variance (ANOVA) shows that the WWCs did not differ significantly from the 10% MSCs (<0.05) in the sensory attributes of colour, odour, taste, aroma and general acceptability. However, at higher mushroom flour supplementation, varying significant differences occur in comparison with the whole wheat cookies at the same probability level. Hence, mushroom flour substitution at 10% in cookies production would therefore make a good and acceptable sensory attributes with probably no significant differences from the whole wheat cookies. The ranking test conducted reveals that the WWCs was preferred in terms of all attributes tested followed by the 10% MSCs samples. This could be as a result of the familiarization of the consumers to the normal whole wheat cookies. It is believed that

public enlightenment on the nutritional importance of mushroom fortified foods would help enhance the acceptability of the mushroom supplemented cookies.

Data on the microbiological characteristics of the sample are presented in table 3. While no microorganism were detected in the unsubtituted sample, the total viable bacterial count increased from 12 to 31 in the samples with 10% and 30% level of supplementation respectively. The trend in mold population was similar. No coliform were detected in any of the samples suggesting that all the samples might be free of faecal contamination. The relatively presence of other bacteria and molds might be due to the processing which mushroom is subjected to. However, the high temperature of baking is expected to destroy all microorganisms present.

CONCLUSION

The results of this investigation have demonstrated that it is possible and may be desirable to partially substitute wheat flour with mushroom flour for the purpose of cookies production. It has been shown that substitution up to 20% did no significantly affect the physical and baking properties of the flour and were nutritionally superior to that of the whole wheat flour. The sensory attributes were not significantly affected.

Table 2: Proximate composition of the wheat Mushroom flour cookies

Samples WF: MF %	Moisture Content (%)	Protein %	Fat %	Ash %	Crude fibre %	Carbohydrate %
100:0	10.83	12.15	5.44	2.49	3.47	65.62
90:10	9.58	12.98	6.49	2.66	3.65	64.64
80:20	9.48	13.77	6.77	2.77	3.75	63.46
70:30	9.25	14.05	6.85	5.50	4.22	60.13

Mean with different superscript in a row are significantly different ($p<0.05$)
WF: Wheat flour MF: Mushroom Flour

Table 2: Sensory Evaluation of wheat – Mushroom Flour Cookies General Samples

WF: MF	Colour	odour	Aroma	Taste	Crispness	Grittiness	Overall acceptability
100:0	6.6 ± 1.2^a	6.2 ± 1.2^a	6.8 ± 1.2^b	6.6 ± 1.2^a	8.7 ± 1.2^a	6.0 ± 1.2^b	6.9 ± 1.2^a
90:10	5.7 ± 1.2^a	6.2 ± 1.2	6.8 ± 1.2^b	5.5 ± 1.2^a	8.5 ± 1.2^a	6.0 ± 1.2^b	6.1 ± 1.2^a
80:20	5.7 ± 1.2^a	6.0 ± 1.2^a	6.8 ± 1.2^b	5.4 ± 1.2^a	8.1 ± 1.2^a	6.0 ± 1.2^b	5.8 ± 1.2^b
70:30	5.4 ± 1.2^a	6.0 ± 1.2^a	6.1 ± 1.2^b	5.2 ± 1.2^a	7.7 ± 1.2^b	6.7 ± 1.2^b	5.4 ± 1.2^b

Mean scores in column with same letters are not significantly different ($p<0.05$)
WF: Wheat flour MF: Mushroom Flour

Table 4: Microbiological Analysis of Wheat – Mushroom Flour Cookies

Sample Mushroom flour (%)	Total viable count (×10)	Coliform count (×10)	Mould count (×10)
0(100%wheat)	00	00	00
10	12	00	12
20	21	00	18
30	31	00	25

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