**Research Journal of Food and Nutrition**
**Volume 3, Issue 4, 2019, PP 1-5**
**ISSN 2637-5583**

# Effect of Mushroom *(Coprinellus micaceus)* Flour Addition on the Quality Characteristics of Millet-Based *Ibyer*

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## ABSTRACT

*Ibyer (a traditional cereal-based porridge) was produced from millet (Pennisetumglaucum) and mushroom (Coprinellus micaceus) flour blend. Sample A (100% millet flour) served as the control while sample B contained millet-mushroom flour in the ratio 90:10. Proximate, mineral, vitamin, functional and sensory attributes of the samples were evaluated. There was significant (p<0.05) increment in protein (13.80 to 17.05%), ash (2.06 to 7.96%), moisture (4.32 to 4.92%) and fat(4.32 to 7.14%) contents with mushroom flour addition. Conversely, carbohydrate and crude fibre contents decreased significantly (p<0.05) from 63.94 to 53.50%and 11.25% to 9.46% respectively. Mineral content of ibyer increased significantly (p<0.05) with addition of mushroom flour from 399.00 to 3275.00 mg/100g, 1095 to 4086 mg/100g, 44.50 to 164.00 mg/100g, 48.00 to 796.00 mg/100g and 520 to 725.00 mg/100g for calcium, iron, magnesium, phosphorus and potassium contents respectively. Furthermore, significant (p<0.05) increment in vitamin content was observed with incorporation of mushroom flour from 64.50 to 360.00mg/100g, 420.00 to 1880.00mg/100g, 260.00 to 312.00mg/100g, 23.00 to 234.00mg/100g and 81.00 to 200.00mg/100g for pro-vitamin A, vitamins B1, B2, B6, and C respectively. Increase in water absorption capacity (1.71 to 1.95 g/g), oil absorption capacity (1.33 to 1.95 g/g), swelling capacity (2.17 to 2.54 %) and bulk density (0.61 to 0.66 g/ml)with mushroom flour incorporation was significant (p<0.05). Although the ibyersamples were not significantly (p>0.05) different in sensory attributes, the mushroom-blended sample was most accepted in terms of taste, flavor, colour and general acceptability.*

**Keywords:** *Mushroom, Ibyer, millet, cereal-based porridge.*

## INTRODUCTION

In order to meet the challenging food needs in the developing world, utilization of healthy locally available foods have been advocated either as whole or partial replacement for cereal and tuber-based foods which seem to be the main staples for many individuals [1]. *Ibyer* is an indigenous, non-alcoholic cereal-based porridge made from maize, sorghum, or millet which is consumed by many individuals in Nigeria. It is prepared by cooking reconstituted cereal flour or wet milled paste in water. The type of cereal grains used, variety, milling technique, particle sizes, steeping and cooking techniques all account for the overall textural quality of the porridge [2].

Millet, the most preferred cereal for *Ibyer* production, is widely cultivated in Nigeria and consumed as one of the staple food commodities. Millet is a good source of carbohydrates and protein but is limited in lysine, threonine, and tryptophan. It is also rich in micronutrients, antioxidants and phytochemicals [3].

Mushroom is a fleshy spore-bearing fruiting body of a fungus found on soils, woods and tree barks. They grow mainly during the rainy season and are amongst the well-known and documented edible forest product [4]. *Coprinellus micaceus* is an edible mushroom containing high amount of essential amino acids, micronutrients and bioactive compounds with potentials for use in supplementation of cereal foods [5].

Millet-based *Ibyer*, like most traditional cereal gruels and porridges are usually high fibre diets with low nutrient density which may not provide sufficient nutrients needed to sustain growth and so require some form of enrichment [6, 7]. However, information on the use of *C. micaceus* flour in supplementing traditional cereal-based porridges is lacking. The aim of the study was to evaluate the quality of millet-mushroom *Ibyer*.

## MATERIALS AND METHODS

### Source of Raw Material

Fresh *C. micaceus* mushroom stems were handpicked at the base of dead African locust bean (*Parkiabiglobosa)* in Buruku Local Government Area of Benue State. Millet (*Pennisetumglaucum*) was purchased from Wurukum market, Makurdi, Benue state.

### Sample Preparation

Mushroom flour was prepared according to the method described by Ojo*et al* [13] with slight modifications. Fresh mushrooms were washed in clean water and blanched at 100°C for 5min after which they were sun dried, milled using attrition mill(YC100L2-model, 2HP capacity), sieved(500 microns), packaged in sealed polyethylene bags and stored at ambient temperature (25±2°C) until further usage.

Millet flour was prepared according to the method described by Ingbian and Adegoke [8]. The millet grains were sorted, washed in clean water and sundried. They were then milled using a hammer mill (Brook Crompton, Huddersfield England, BS 5000-99) and sieved (500 microns). The sieved flour was packaged in sealed polyethylene bags and stored at ambient temperature (25±2°C) until further usage.

### Blend Formulation

90% millet flour was blended with 10% mushroom flour, designated as sample B. The control sample (100% millet) was designated as sample A.

### Production of Millet-Mushroom *Ibyer*

Millet-mushroom flour sample was reconstituted in water (1:1w/v) to form paste. The paste was then cooked in boiling water (400ml per 100g paste) with continuous stirring for 10 min.

### Physicochemical Analyses

Proximate composition, selected mineral and vitamin content of the *Ibyer* samples were determined using the standard methods of AOAC [9]. Functional properties were determined using the methods described by Onwuka [10].

### Sensory Evaluation

Sensory evaluation of *Ibyer* from millet and mushroom flour blend was carried out using a15-member panel to evaluate attributes such as appearance, taste, aroma, and overall acceptability based on a 9- point Hedonic scale (where 9 represented like extremely and 1, dislike extremely) as described by Iwe [11].

### Statistical Analysis

Experiments were conducted in duplicates. Data obtained was subjected to Two Sample T-test. Significant difference was accepted at 5% level of probability ($p<0.05$).Genstat package, version 17.0 was used for the analysis.

## RESULTS AND DISCUSSION

The effect of mushroom flour addition on the proximate composition of millet flour is presented in Table 1. Significant ($p<0.05$) increment in protein (13.8 to 17.05%), moisture (4.32 to 4.92%), ash (2.06 to 7.96%) and fat (4.32 to 7.14%) content was observed with addition of mushroom flour. Conversely, crude fibre and carbohydrate content decreased from 63.94% to 53.50% and 11.25% to 9.46% respectively with addition of mushroom flour. This is in agreement with reports of other researchers that edible mushrooms generally have high amounts of protein, ash and fat contents [12, 13]. The decrease in carbohydrate content may be due to the dilution effect of mushroom flour since they are generally low in carbohydrate [14]. Okafor *et al.* [12] observed similar decrease in carbohydrate and crude fibre content of wheat-mushroom bread.

**Table1.** *Effect of Mushroom (Coprinellus micaceus) flour addition on the proximate composition (%) of millet flour*

| Parameter | A | B | P-value |
|---|---|---|---|
| Protein | 13.80±0.01 | 17.05±0.01 | 0.001 |
| Moisture | 4.32±0.01 | 4.92±0.01 | 0.001 |
| Ash | 2.06±0.01 | 7.96±0.01 | 0.001 |
| Fat | 4.63±0.03 | 7.14±0.01 | 0.001 |
| Crude fibre | 11.25±0.00 | 9.46±0.00 | 0.001 |
| Carbohydrate | 63.96±0.05 | 53.50±0.01 | 0.001 |

** Values are means ± standard deviation of duplicate determinations. Means in the same row with p-value less than 0.05 differ significantly ($p<0.05$).*

***Key:*** *A=100% millet flour, B=90% millet flour+10% mushroom (Coprinellus micaceus) flour*

The reduction in crude fibre content is in contrast with the report of Ojo *et al.* [14] who also reported that fibre content of mushroom may vary based on genetic structure of specie, physical and chemical difference in growing medium, composition of the substrate and harvest time. Table 2 shows the effect of mushroom flour addition on selected minerals and vitamins of millet flour. Addition of mushroom flour into millet flour resulted in significant ($p<0.05$) increment in pro-vitamin A, vitamins, B1, B2, B6 and C, consistent with the findings of Matila*et al.* [15]. Calcium, iron, magnesium, potassium and phosphorus contents of the mushroom-supplemented sample were higher than that of the control flour, similar to the findings of Okoro and Achuba [6].The benefits of vitamins and minerals are well documented in literature [16]. Mineral concentration in mushrooms has been reported to be higher than those in meat and fish and may act as a suitable supplementary food especially for populations who depend largely on cereals [5].

**Table2.** *Effect of Mushroom (Coprinellus micaceus) flour addition on selected vitamins and minerals of millet-mushroom flour*

| Parameter | A | B | P-value |
|---|---|---|---|
| Pro-vitamin A | 64.54±0.71 | 360.00±14.14 | 0.001 |
| Vitamin B1 | 4.20±0.71 | 18.80±141.42 | 0.004 |
| Vitamin B2 | 2.60±14.14 | 31.25±17.68 | 0.005 |
| Vitamin B6 | 2.30±2.83 | 23.40±1.41 | 0.001 |
| Vitamin C | 81.0±0.00 | 200.00±14.14 | 0.007 |
| Calcium | 39.90±1.41 | 328.00±49.50 | 0.008 |
| Iron | 10.95±70.70 | 40.68±63.70 | 0.012 |
| Magnesium | 44.50±0.71 | 164.00±9.89 | 0.028 |
| Phosphorus | 48.00±0.00 | 79.60±6.46 | 0.003 |
| Potassium | 520.00±0.00 | 725.00±7.07 | 0.001 |

** Values are means ± standard deviation of duplicate determinations. Means in the same row with p-value less than 0.05 differ significantly ($p<0.05$).*

***Key:*** *A=100% millet flour, B=90% millet flour+10% mushroom (Coprinellus micaceus) flour*

Incorporation of mushroom flour into millet flour resulted in increment in water absorption capacity (1.71 to 1.95 g/g), oil absorption capacity (1.33 to 1.95 g/g), swelling capacity (2.17 to 2.54) and bulk density (0.61 to 0.66 g/ml) (Table 3). The increase in the water absorption capacity could be due to the increase in protein content of the product, resulting in higher water binding sites [13]. The higher oil absorption capacity of the mushroom-supplemented flour may favour sensory appeal of the product [17]. Furthermore, higher swelling capacity of products has been reported to confer good textural and flow characteristics [18], which is a major flour requirement for *Ibyer* production. Bulk density of foods gives an indication of their nutrient density and is important in determining their packaging requirements [19]. The higher bulk density of the millet-mushroom flour suggests that the same quantity of the product consumed in comparison with the control flour will result in a higher nutrient density20].

**Table3.** *Effect of mushroom (Coprinellus micaceus) flour addition on the Functional properties of millet-mushroom flour*

| **Parameter** | **A** | **B** | **P-value** |
|---|---|---|---|
| Water Absorption Capacity (g/g) | 1.71±0.07 | 1.95±0.00 | 0.34 |
| Oil Absorption Capacity (g/g) | 1.33±0.05 | 1.95±0.00 | 0.66 |
| Swelling Capacity (%) | 2.17±0.00 | 2.54±0.12 | 0.04 |
| Bulk Density (g/ml) | 0.61±0.00 | 0.66±0.00 | 0.39 |

** Values are means ± standard deviation of duplicate determinations. Means in the same row with p-value less than 0.05 differ significantly ($p<0.05$).*

***Key:*** *A=100% millet flour, B=90% millet flour+10% mushroom (Coprinellus micaceus) flour*

Although, values for taste, texture, aroma and appearance were higher in the millet-supplemented *Ibyer*, there was no significant difference between the samples (Table 4). Mushrooms are reported to contain volatile compounds which are responsible for improving aroma and taste [21]. In terms of overall acceptability, the mushroom-supplemented *Ibyer* was preferred over the control.

**Table4.** *Effect of mushroom (Coprinellus micaceus) flour addition on the sensory attributes of millet-based Ibyer*

| Parameter | A | B | P-value |
|---|---|---|---|
| Taste | 7.20 | 7.67 | 0.097 |
| Texture | 6.47 | 6.47 | 0.061 |
| Flavor | 6.33 | 7.20 | 0.079 |
| Color | 6.27[a] | 6.53 | 0.060 |
| General Acceptability | 6.73 | 7.93 | 0.003 |

**Means in the same row with p-value less than 0.05 differ significantly (p<0.05)*

***Key:*** *A=100% millet flour, B=90% millet flour+10% mushroom (Coprinellus micaceus) flour*

## CONCLUSION

The study shows that nutritious and acceptable *Ibyer* can be produced frommillet supplemented with 10% mushroom. Regular consumption of the product may be helpful in enhancing the nutritional status of consumers, especially in developing regions of the world.

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**Citation:** *Tersoo-Abiem, E. M, Gbaa, S.T, Sule, S, "Effect of Mushroom (Coprinellus micaceus) Flour Addition on the Quality Characteristics of Millet-Based Ibyer", Research Journal of Food and Nutrition, 3(4), 2019, pp. 1-5.*