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Nutritive Value of Common Wild Edible Mushrooms from Southern Nigeria

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Abstract: Young and matured carpophores of twelve (12) common wild edible Nigerian mushrooms were collected from different locations at the southern part of Nigeria. These fungi were analyzed for proximate and mineral elements compositions. The results showed that all the tested samples contained appreciable amount of essential nutrients. Of the entire wild mushroom tested, *T. globulus* was the richest containing highest amount of protein, ash, calcium, phosphorus and iron. This was followed in order by *T. microcarpus*, *V. esculenta*, *L. giganteum* and *L. pusilum* ($p<0.05$). The highest amount of moisture (98.5%) was found in the matured fruitbodies of *L. pusilum* followed by *A. polytricha* (97.1%) and *L. giganteum* (96.9%). *Lycoperdon giganteum* contained greatest amount of soluble sugars and glycogen while *V. esculenta* was the richest in total lipid containing 17.7% of the mushroom dry weight. Generally, the young fruitbodies of all the tested fungal samples were found to be richer than the matured fruitbodies. This study also reveals that *T. microcarpus*, *P. atroumbonata*, *L. pusilum* and *V. esculenta* contained abundant amount of K, Na, Mn and Cu respectively.

Key words: Nutritive value · mushrooms · carpophores · mineral nutrients · analysis

INTRODUCTION

Macro fungi such as mushrooms, puffballs and morels are important dietary components in many countries of the world. In Nigeria, edible mushrooms are used for medicinal purposes and these fungi also serve as important article of food [1-4].They are usually collected from the wild during the rainy season because the few available mushroom farms are unable to meet market demand of Nigerians.

In the southern part of this country, edible higher fungi are considered as luxury food and important table delicacy especially among the rural dwellers. Mushrooms such as *T. robustus T. globulus*, *V. esculenta*, *V. volvacea*, *L. subnudus* and young sporophores of *P. tuber-regium* are usually served as alternative to meat [5, 6]. This is because people living in the villages are exposed to the natural vegetation (tropical rain forest) in which mushrooms grow.

During the rainy season, different species of both edible and non edible species usually grow on various natural substrates such as garden soil, decaying wood, termite nest, palm wastes, leaf litters, under the shade provided by cocoa, teak, coffee and rubber plantations. People in the villages (mushroom hunters) usually wake up early in the morning to look for wild edible mushrooms. The mushroom hunting activities is always an interesting, competitive, rewarding and profitable venture especially among the women. The collected edible species are usually sorted out, cooked or sold in the local markets. Alternatively, *Termitomyces* and *Volvariella* species may be hawked along the local and major roads to attract the attention of buyers [5, 7].

Mushrooms growing in the wild have been found to be nutritious and important for medicinal purposes [8-12]. Mushrooms have been considered as rich food because they contain protein, sugars, glycogen, lipids, vitamins, amino acids and crude fibres. They also contain important mineral nutrients, which are required for normal functioning of the body [3, 13, 14]. Infact, Bano [15] suggested that food value of mushrooms lies between meat and vegetables.

A number of factors usually influence the nutritional composition of mushrooms. These factors include

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growing site, type of substrates, mushroom type, developmental stages and part of the fungal samples analyzed [11, 16]. Although, there have been few studies on nutritional values of cultivated Nigerian mushrooms, there is little or no information available on wild edible higher fungi of Nigeria especially in their natural habitats. Therefore, this study focuses on the nutritional quality of wild edible mushrooms collected from the natural vegetation of Southern Nigeria.

MATERIALS AND METHODS

Sample collection and preparation: The sporocarps of test fungi were procured from their natural habitat at various locations across the southern part of Nigeria. The type of vegetation at the sites of collection consisted of a typical tropical rain forest. Collected samples were *Auricularia polytricha* (Mont), *Lentinus subnudus* (Berk), *Lycoperdon pusilum* (Bat. Ex), *Lycoperdon giganteum* (Pers), *Pleurotus florida* (Mont) Singer, *Pleurotus tuber-regium* (Fries) Singer, *Psathyrella atroumbonata* (Pegler), *Shizophyllum commune* (Fries), *Termitomyces microcarpus* (Berk), *Termitomyces globulus* (Heim), *Tricholoma lobayensis* (Heim) and *Volvariella esculenta* (Mass) Singer. Collection was done between July 2005 and June 2006. The location of their collection and their habitats are summarized on Table 1. The mushroom samples were identified by their various characteristics using the standard descriptions of Zoberi [17] and that of Alexopolous *et al*. [18]. For analysis, fruitbodies were dried in the oven at 80°C for 48 h and powdered in a Moulinex blender. The fine powdered samples were stored in the desiccators and employed for proximate and mineral nutrients analysis. All the analyses were done in triplicate.

Moisture content: The fresh weight of each mushroom sample was taken using chemical balance. These samples were then oven dried separately at 80°C for 48 h. The loss in weight obtained after drying was regarded as the moisture content [9].

Dry matter content: This was taken as the final weight obtained after the sample have been dried in the oven at 80°C for 48 h.

Ethanol soluble sugar: One gramme (1.0 g) of the powdered mushroom sample was extracted with 30.0 cm^3 of 80% ethyl alcohol in a soxhlet extractor for 6 h. The crude extract was diluted to 100.0cm^3 with 80% ethyl alcohol. The quantity of ethanol soluble sugar in the extract was determined using phenol sulphuric acid method of Dubois *et al*. [19].

Ash content: The powdered mushroom sample (3.0 g) was ashed in a Gallenkamp furnance in previously ignited and cooled crucible of known weight at 550°C for 6 h. Fairly cooled crucibles were put in desiccators and weighed [10].

Glycogen content: Glycogen content was quantified using the anthrone method described by Fasidi and Kadiri [20].

Lipids: Two gramme (2.0 g) of powdered sample was extracted with 30.0 cm^3 of petroleum ether in a soxhlet extractor for 4 h. The extract was evaporated to dryness in a weighed flask using a vacuum evaporator. The weighed flask was dried in the oven at 80°C for 2 h, allowed to cool and reweighed. The difference between the initial and final weights was regarded as the lipid content of the sample [21].

Protein content: Protein content was determined using folin phenol reagent [22]. 0.5 g of the powdered mushroom sample was extracted with 50.0 cm^3 of 2% NaCl in a water-bath at 60°C for 1 h. The extract was filtered out and 50.0 cm^3 of 3% copper acetate monohydrate were added to the filtrate to precipitate protein. The precipitated protein was then centrifuged out and dissolves in 50 cm^3 of 0.1 m NaOH. The quantity of protein in the alkaline solution was then determined using the folin-phenol method [22].

Crude fibre: Crude fibres of the mushroom samples were determined according to the standard method Association of Official Agricultural Chemists, AOAC [23].

Mineral nutrients: Calcium, magnesium, sodium, potassium, manganese, phosphorus, iron, copper and zinc were determined by automated atomic absorption spectrophotometry and flame photometry method [24].

Analysis of data: All experiments were carried out in three replicates and the data obtained from each study were subjected to Analysis of variance(ANOVA).Tests of significance were carried out using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Table 1 shows that several naturally growing edible mushrooms could be found in different states of southern

Table 1: State of collection, habitat and spore print of wild mushroom samples from Southern Nigeria

Mushroom sample	States of collection	Habitat	Spore print
Auriculana polytricha	Akwa Ibom, Oyo, Rivers,	Deadwood (*Terminalia ivorensis*)	Ochraceons
Lentinus subnudus	Bayelsa, Ondo, Osun	Deadwood (*Spondias mombia*)	White
Lycoperdon pusilum	Oyo, Ogun, Edo	Damped soil (Under shade)	Light brown
Lycoperdon giganteum	Oyo, Ogun, Osun	Soil among fallen leaves	Brown
Pleurotus tuber-regium	Ondo, Edo, Rivers	Wood (*Trema orientalis*)	White
Pleurotus florida	Osun, Rivers, Oyo	Base of rotten *Magnifera indica*	Hyalie
Psathyrella atroumbonata	Edo, Ogun	Solid Base of dead *Terma orentalis*	White
Schizophyllum commune	Delta, Oyo, Osun, Edo	Deadwood *Ceiba pentrads*	White
Termitomyces microcarpus	Ogun, Oyo, Osun	Termite nest	Bright yellow
Termitomyces globalus	Osun, Oyo, Edo	Termite nest	Hyalie
Tricholoma lobayensis	Rivers, Oyo, Edo	Soil hidden plant debris	Hyalie
Volvariella esculenta	Ogun, Osun, Oyo	Oil Palm waste	Pink

Table 2: Proximate composition of young (YFB) and Matured Fruit Bodies (MFB) Data are calculated as % dry weight except 'A' and 'B' which are % fresh weight

Mushroom samples	Moisture content	Dry matter content	Soluble sugars	Total lipids	Glycogan content	Protein content	Circle fibre content	Ash content
A. polytricha YFB	97.1b	2.9h	4.8i	4.9h	5.7g	9.3i	3.4i	4.7h
A. polytricha MFB	95.6d	4.4g	5.9hi	5.2gh	7.3g	8.5ij	3.5i	5.2gh
L. subnudus YED	92.8g	7.2d	11.4d	3.6i	15.8cd	6.5j	4.3hf	5.9g
L. subnudus MFB	90.3i	9.7c	8.9ef	4.5h	10.7ef	5.1j	6.5g	7.1fg
L. pusilum YFB	95.0d	5.6ef	13.7c	7.2de	16.7c	24.3e	3.5i	4.5h
L. pusilum MFB	98.5a	1.5h	15.7b	7.9d	20.1b	23.7e	5.1gh	8.6f
L. giganteum YFB	96.9c	3.6g	16.9ab	10.5ab	22.4b	25.3de	4.5hi	6.3g
L. giganteum MFB	95.7d	4.3g	17.5a	10.0bc	25.8a	23.3e	5.57g	15.5b
P. tuber-regium MFB	88.6k	11.4b	7.7g	1.7jk	10.7ef	16.3fg	15.6a	9.2ef
P. florida YFB	94.7e	5.8ef	9.4e	0.9kl	12.5e	15.3fg	3.5i	9.7ef
P. florida MFB	91.8h	7.6d	8.5fg	1.2k	11.5e	14.9g	5.3gh	11.5c
P. atroumbonata YFB	90.4i	9.6c	7.9g	5.2g	12.5e	18.5f	10.7d	10.3e
P. atroumbonata MFB	89.9j	10.1c	7.8g	6.3ef	13.1e	16.3fg	12.6bc	9.0ef
S. commune YFB	87.3i	12.9b	9.2e	5.2g	10.7ef	10.5hi	6.5g	10.1e
S. commune MFB	85.4m	14.6a	8.3fg	5.8fg	11.8ef	10.1hi	10.1d	13.1c
T. microcarpus YFB	90.3i	9.7c	14.7c	8.1d	19.5b	28.1c	12.1bc	11.7cd
T. microcarpus MFB	88.2k	11.8b	13.6c	9.4c	16.2c	27.3cd	13.7b	14.1bc
T. globulus YFB	92.3g	7.7d	15.4bc	7.1de	19.8b	34.1a	9.6de	17.3a
T. globulus MFB	90.5i	9.5c	13.9c	6.3ef	18.4bc	31.5b	11.1cd	14.3bc
T. lobayensis YFB	93.9f	6.1de	7.6g	3.8i	10.7ef	13.9g	7.2fg	9.3ef
T. lobayensis MFB	91.0h	9.0c	7.9g	4.6hi	10.1ef	13.1g	9.8de	9.5ef
V. esculenta YFB	95.7d	4.9fg	10.8d	11.1a	14.7de	26.7d	5.7g	14.5bc
V. esculenta MFB	94.5e	5.5ef	8.9ef	10.8ab	10.6ef	25.4d	8.3ef	10.8e

Means followed by the same letter(s) are not significant different by DMRT ($P \leq 0.05$)

Nigeria. This result is not a surprise because the vegetation of these areas is majorly a typical of tropical rainforest, which support the luxuriant growth of wild fungi. Although specific mushroom species were collected from nine states of southern Nigeria, this does not indicate that a species collected from a particular state could not be found in other Nigerian states. The results only gave indication of the areas where the sporocarps could be collected in very large quantities. This result is similar to that obtained by Zoberi [17], Alofe *et al*. [2] and Jonathan [5],

From Table 1, it was observed that the moisture content of the collected mushroom samples ranges from 85.4 to 98.5%. The matured sporocarps of *L. pusilum* contained the highest amount of moisture (98.5%) with the lowest amount of dry matter (DM) (1.5%). This was follow in order by young sporocarps of *A. polytricha* (97.1%) DM (2.9%), *L. giganteum* (96.4%) DM (3.6%) and *V. esculenta*(94.5%) DM (5.5%). This high moisture content is an indication that fresh mushrooms cannot keep for long time. This is because high water activity enhances microbial growth [25]. Similar observation was

Table 3: Mineral element contents of collected mushrooms (Data are calculated as mg/100g of the dry weight)

Mushroom samples	Ca	Mg	K	Na	P	Mn	Fe	Cu	Zn
A. polytricha YFB	0.6ij	1.7f	35.1f	0.3j	20.0cd	0.30de	0.65bc	0.15a	0.07d
A. polytricha MFB	0.9i	1.2fg	40.3e	0.4j	19.7cd	0.29f	0.70b	0.10b	0.06d
L. subnudus YFB	1.6gh	2.9e	23.3ij	2.3e	2.7h	0.08g	0.50c	0.10h	2.05h
L. subnudus MFB	1.9gh	2.0ef	21.0ij	2.0efg	2.3h	0.07g	0.55c	0.15a	1.90c
L. pusilum YFB	0.9i	3.7cd	30.1gh	1.7gh	15.7e	1.01a	0.70b	0.17a	1.2cd
L. pusilum MFB	1.4hi	4.1c	27.5h	2.3ef	13.3ef	0.80b	0.75b	0.16a	1.40cd
L. giganteum YFB	3.7d	3.3d	47.1cd	3.3c	20.0c	0.90ab	0.40d	0.07b	0.90d
L. giganteum MFB	4.9b	2.9e	41.3e	3.7c	21.9c	1.00a	0.50c	0.06b	0.70d
P. tuber-regium YFB	1.7gh	0.9g	7.8m	1.3gh	3.6h	0.10g	0.35de	0.02b	1.80e
P. tuber-regium MFB	2.1fg	0.7g	10.5lm	1.7h	4.6h	0.20fg	0.30de	0.02b	2.03bc
P. florida YFB	0.3j	1.3fg	13.1kl	0.2j	13.0ef	0.90a	0.09g	0.05b	0.50d
P. florida MFB	0.5ij	1.7f	14.6k	0.3j	13.7ef	0.70b	0.07g	0.05b	0.50d
P. atroumbonata YFB	3.1e	4.1c	45.1cd	6.3ab	15.7e	0.50c	0.20f	0.07b	0.75d
P. atroumbonata MFB	0.5i	5.0b	41.6e	6.7a	14.3e	0.40cde	0.20f	0.07b	0.80d
S. commune YFB	3.1e	0.4g	16.5jk	0.5j	8.3g	0.30de	0.10g	0.08b	1.10c
S. commune MFB	4.7b	0.7g	17.1i	0.8ij	7.9g	0.30de	0.10g	0.08b	1.30c
T. microcarpus YFB	3.1e	3.1de	60.1a	2.3ef	25.1b	0.70b	0.70b	0.07b	2.85a
T. microcarpus MFB	3.9d	4.2c	57.4d	1.7gh	23.3bc	0.75b	0.70b	0.07b	2.85a
T. globulus YFB	5.7a	5.3b	50.3c	1.5h	32.4a	0.80b	0.90a	0.08b	3.05a
T. globulus MFB	4.9b	6.7a	46.5de	1.9fg	29.8a	0.90ab	0.80b	0.09b	3.15a
T. lobayensis YFB	1.3hi	0.4g	15.5jk	2.2f	9.7g	0.30de	0.30de	0.09b	0.80d
T. lobayensis MFB	1.7gh	0.7g	21.7i	2.0fg	10.3g	0.29e	0.35de	0.16a	0.90d
V. esculenta YFB	0.6ij	2.7e	53.4bc	6.1bc	18.6d	0.45cde	0.45d	0.18a	2.30bc
V. esculenta MFB	1.0i	2.2ef	49.5cd	5.7c	18.9d	0.43cde	0.40d	0.04b	2.70ab

Means followed by the same superscript letter(s) within each column are not significantly different ($p \leq 0.05$) by DMRT. YFB-young fruitbodies, MFB-matured fruit bodies

made by Fasidi [3] for *V. esculenta* Leon Guzman *et al*. [26] for mushrooms of Queretaro Mexico and Sanmee *et al*. [11] for Thailand mushrooms.

Of all the higher fungi investigated, *T. globulus* was the richest containing highest amount of protein, ash, calcium, phosphorus and iron (Tables 2 & 3). This was followed is order by *T. microcarpus*, *V. esculenta*, *L. giganteum* and *L. pusilum* ($p<0.05$). This observation could be used to explain the reason why *Termitomyces* species are the most sought mushrooms among the Yoruba people of south-western Nigeria [1, 27]. Generally, all the mushrooms analysed had very high amount of protein. This result agrees with the earlier work done on the sporophores of *P. tuber-regium*, *L. subnudus* and *T. robustus* by Kadiri and Fasidi [22], Fasidi and Kadiri [28]. Hence, the fruitbodies of wild edible Nigerian mushrooms can be eaten as a protein supplement or as an alternative to fish and meat in rural areas where these items could not be affordable. Vegetarians could also eat mushrooms because it served as alternative protein supplements in their diet. Mushroom proteins are generally higher than those of green vegetables and oranges [5, 29].

Table 2 also shows that ethanol soluble sugar and lipid contents of the collected mushrooms were generally low. This suggests that diabetics and those with heart or weight problems can consume wild edible Nigerian mushrooms [29]. *Pleurotus tuber-regium* had the highest amount of crude fibre (Table 2). Crude fibres together with calcium are strengthening materials for mushrooms. Their abundance in the matured fruitbodies of *P. tuber-regium* may be to reinforce the stipe for mechanical support. Matured fruitbodies of *P. tuber-regium* is tougher than the young sporocarps [30].

Calcium was the most abundance mineral element in *T. globulus* (YFB). This was followed by *L. giganteum* (MFB) and *T. microcarpus* (MFB) (Table 3). Similar results were also obtained by Fasidi and Kadiri [20] and Fasidi and Ekuere [8]. The preponderance of calcium in the fruitbodies of these mushrooms may be due to the absorption and accumulation of this element from their habitat. *Termilomyces globulus* has the richest of phosphorus closely followed by *T. microcarpus* (Table 3). This result agrees with the report of Oso [1] that *T. globulus* was rich in essential food nutrients.

In regard to potassium, *T. microcarpus* was the richest followed in order by *V. esculents* and *T. globulus*. These three mushrooms are important food delicacy among the people of southern Nigeria. This result is similar to the obtained by earlier workers [21, 24, 31, 32]. The highest amount of sodium was found in *V. esculenta* (Table 3). Similar observation was made by Fasidi and Kadiri [20] for the same fungus.

Trace elements such manganese, Iron, copper and zinc were found in required quantities in these mushrooms. The results obtained for micro elements could be compared with the observation of Isiloglu *et al*. [32].

From these studies (Tables 1 & 2), Young fruitbodies of the collected species are generally richer in protein than the matured fruitbodies. Therefore it is suggested that the young sporocarps should be preferred than the matured fruitbodies.

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