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# Collection, morphological characterization and nutrient profile of some wild mushrooms from Akoko, Ondo state, Nigeria

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## ABSTRACT

A total number of twenty-six different wild mushrooms namely Agaricus blazei, Agaricus sp, Coprinus africanus, Corilopsis occidentalis, Coriolus vesicolor, Cymatoderma elegans, Daedalea sp, Daldinia concentrica, Filoboletus gracilis, Fomes sp, Fomes noxius, Lactarius hygrophoroides, Panus sp, Marasmius arborescens, Marasmius zenkeri, Panus fulvus, Microporus xanthopus, Nothopanus hygrophanus, Polyporus sp, Polyporus dermoporus, Schizophyllum sp, Termitomyces clypeatus, Termitomyces globulus, Pleurotus tuber-regium, Pogonomyces hydnoides and Podoscypha bollena were collected from typical tropical rain forests in Akoko area of Ondo state, Nigeria. Akoko land is an area, located in between 7º00'N and 8º00'N latitude and 5º30'E and 6º15'E longitude with a wide range of ecosystems and species diversity. The criteria used in the identification were habitat, morphological and physical characteristics such as spore morphology, cap type, presence of veil, gills, presence of volva, sizes of mushroom and colour of the sporophores Agaricus sp contained the highest crude protein (37.09%) followed in order by Termitomyces globulus (31.77%), Termitomyces clypeatus (19.82%) and Pleurotus tuber-regiun (12.14%). Other food materials found in significant quantities in these mushroom are ethanol soluble sugars and mineral elements such as Ca, K, P, Mg and Fe ($P<0.05$). The significance of these observations were discussed.



## KEYWORDS

Akoko land;
Wild mushrooms;
Morphology;
Food values;
Characterization.

## INTRODUCTION

Mushrooms otherwise known as higher fungi are natural gift which have not been trapped adequately. In Europe and some Asian countries, edible mushrooms have been cultivated commercially and are used for various purposes in food and pharmaceutical industries[1-3]. Among the rural dwellers in Nigerian villages, edible mushrooms also constitute major source of food condiments[13,18]. These group of fungi have also been reported as good sources of medicines by Nigerian traditional doctors[13,20,25]. Mushrooms being saprophytes, are not photosynthetic in nature, therefore they exhibit heterotrophic mode of nutrition. In the kingdom fungi, only two classes contained members with macroscopic fruiting bodies. These are Basidiomycetes and few species of Ascomycetetes[3,26]. They usually grow on richly humus soil or dead organic matter while some may be parasitic in nature. Higher fungi could also utilize almost all agro-industrial wastes as substrates. They could grow

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on different types of cereal straw, wood wastes, cassava peels, palm wastes, paper wastes, cotton wastes etc[1,7,18,19]. Mycelia of mushrooms consist of fine, thread-like hyphae, which grow massively through the organic rich substrates in the habitat where they grow (Jonathan *et al*). More than 2000 species of mushrooms exist in nature but, less than 50 species are widely accepted as food[7,16,23,24]. According to Fasidi and Kadiri[12], mushrooms contained about 9.73- 17.70% dry matter, 6.25-22.06 % crude fibre, 8.60-17.23% crude protein and 1.68-4.61% lipids. Different types of studies have been carried out on the chemical composition and nutritional qualities of edible mushrooms from different countries, particularly on Spanish[10], Italian[22,23]. Indian[4] and Nigerian[5,11,12,14]. Mushrooms have been reported as therapeutic foods, useful in preventing diseases such as bacterial infections, hypertension, hypercholesterolemia and cancer[8,13,17]. A vast number of mushrooms have been identified with a particular environment depending on the climatic condition of that area. Some of these higher fungi have been found to be poisonous while some have of mushrooms have been employed in food, pharmaceutical and other allied industries[5,11,20]. They have been utilized largely in the biodegradation of cellulolytic materials. It was therefore the objective of the present study to collect, identify and determine useful qualities of wild mushrooms from Akoko Area, in the South Western Nigeria.

## MATERIALS AND METHODS

### Sample collection

The test higher fungi were collected from different secondary forests within Akoko land (Ikare Akoko, Iboropa Akoko, Oka Akoko, Oba Akoko, Irun Akoko, Ikaram Akoko, Isua Akoko, and Epimi Akoko) using the method described by of Jonathan[16]. The collection were done between May and September, 2009. The collected samples were *Agaricus blazei, Agaricus sp, Coprinus africanus, Corilopsis occidentalis, Coriolus vesicolor, Cymatoderma elegans, Daedalea sp, Daldinia concentrica, Filoboletus gracilis, Fomes sp, Fomes noxius, Lactraius hygrohoroides, Panus sp, Marasmius arborescens, Marasmius zenkeri, Panus fuvus, Microporus xanthopus, Nothopanus hygrophanus, Polyporus sp, Polyporus dermoporus, Schizophyllum sp, Termitomyces clypeatus, Termitomyces globulus, Pleurotus tuber-regium, Pogonomyces hydnoides and Podoscypha bollena.* (Plates 1-21). The map of the collection sites is represented on Figure 1.


**Source: Ondo state surveys Akure, Nigeria (1998), Fifth edition.**

**Figure 1 : Map of Ondo state showing Akoko area**

### Sample identification

Preliminary mushroom identification was done by physical examination and spore print procedures described by Zoberi[26]. The confirmed identification was done using the descriptive procedures of Alexopolus *et* al[3] and the completed identification was done using the standard descriptions of Alofe *et al*[1].

### Chemical analyses

Out of the 26 species collected, 4 representative species were analyzed nutritionally. These were *Pleurotus tuber-regium*, *Termitomyces clypeatus*, *Termitomyces globulus* and *Agaricus* sp. These were sundried and milled. They were subjected to proximate compositions using the method of AOAC[6]. Macronutrients and micronutrients contents of these fungal samples were determined out using atomic absorption spectrophotometer (Buck Scientific Atomic Absorption Spectrophotometer, 205 model) following the procedures of Bobek *et al*[8]

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## Analysis of data

All the results in each treatment experiments were subjected to analysis of variance (ANOVA) using general linear model option SAS. Test of significance was determined by Duncan´s multiple range test at 0.5% level of probability

## RESULTS AND DISCUSSION

Species of mushrooms collected for this study were *Agaricus blazei, Agaricus sp, Coprinus africanus,Corilopsis occidentalis, Coriolus vesicolor, Cymatoderma elegans, Daedalea sp, Daldinia concentrica, Filoboletus gracilis, Fomes sp, Fomes noxius, Lactraius hygrohoroides, Panus sp, Marasmius arborescens, Marasmius zenkeri, Panus fulvus, Microporus xanthopus, Nothopanus hygrophanus, Polyporus sp, Polyporus dermoporus, Schizophyllum sp, Termitomyces clypeatus, Termitomyces globulus, Pleurotus tuber-regium, Pogonomyces hydnoides and Podoscypha bollena.* (Plates 1-21; TABLE 1). There were high frequencies and luxuriant growth of these mushrooms in Akoko area of Ondo State, Nigeria. Akoko land is an area, located in between 7º00'N and 8º00'N latitude and 5º30'E and 6º15'E longitude with a wide range of ecosystems and species diversity (Figure 1). The criteria used in the identification were habitat, morphological and physical characteristics such as spore print morphology, cap type and sizes, stalk length presence of veil, gills, presence of volva, sizes of mushroom and colour of the sporophores.(TABLES 1 and 2).

**TABLE 1 : Habitat and morphological characteristics of wildly collected Nigerian mushrooms**

| Code | Habitat | Color of fruiting body | Spore print | Scientific name |
|---|---|---|---|---|
| M1 | Decaying wood | Black | Green and ovate | *Daldinia concentrica* |
| M3 | Buried decaying log of wood | White | cream and smooth | *Panus sp* |
| M4 | Decaying wood | White | Hyaline and rough | *Schizophyllum commune* |
| M5 | Decaying wood | White | Hyaline and smooth | *Fomes sp* |
| M6 | Leaf Litter | Yellowish | Yellowish and spherical | *Marasmius zenkeri* |
| M7 | Decaying log of wood | Brown with greenish covering | White and roundish | *Daedalea sp* |
| M8 | Standing tree | Brown | White and smooth | *Fomes noxius* |
| M9 | Leaf litter | Brown with creamy edge | Hyaline and smooth | *Marasmius arborescens* |
| M10 | Decaying wood | Creamy | Creamy and smooth | *Pogonomyces hydnoides* |
| M11 | Decaying wood | White | White and smooth | *Cymatoderma elegans* |
| M13 | Termite nest | White | Hyaline and smooth | *Termitomyces clypeatus* |
| M14 | Partially buried wood | Brown | White and smooth | *Panus fulvus* |
| M15 | Decaying log of wood | Brown | Hyaline and spherical | *Nothopanus hygrophorus* |
| M16 | Decaying wood | White | White and smooth | *Podoscypha bolleana* |
| M17 | Soil | Reddish | Cream and smooth | *Lactarius hygrophoroides* |
| M19 | Root of standing tree | Brown | White and roundish | *Filoboletus gracilis* |
| M21 | Decaying standing tree | Light green | Black and smooth | *Polyporus sp* |
| M22 | Decaying wood | Brown | hyaline and cylindrical | *Corilopsis occidentalis* |
| M23 | Humus soil | Brown | Brownish and smooth | *Agaricus blazei* |
| M24 | Leaf litter | Light purple | White and smooth | *Coprinus sp* |
| M25 | Log of wood | Blackish brown | Brownish and smooth | *Microporus xanthopus* |
| M26 | Termite nest | Whitish brown | Hyaline and spherical | *Termitomyces globules* |
| M27 | Decaying wood | Creamy with greenish covering | Cream and roundish | *Polyporus dermoporus* |
| M28 | Decaying wood | Creamy | Hyaline and rough | *Coriolus versicolor* |
| M29 | Decaying wood | Creamy | White and spherical | *Pleurotus tuber-regium* |
| M30 | Soil | Brownish cap with white stalk | White and smooth | *Agaricus sp* |

**TABLE 2 : Physical characteristics of the wildly collected Nigerian mushrooms**

| Sample code | Before drying | | After drying | | Scientific name |
|---|---|---|---|---|---|
| | Cap [cm] | Stalk[cm] | Cap [cm] | Stalk [cm ] | |
| M1 | 3.2 | - | 3 | - | *Daldinia concentrica* |
| M2 | 5.4 | 4.8 | 2.6 | 3.3 | *Panus sp* |
| M3 | 1.7 | - | 1.2 | - | *Schizophyllum commune* |
| M4 | 16.8 | - | 14.3 | - | *Fomes sp* |
| M5 | 4.4 | 5.7 | 3.7 | 5.1 | *Marasmius zenkeri* |
| M6 | 5 | - | 4.6 | - | *Daedalea sp* |
| M7 | 7.9 | - | 7.0 | - | *Fomes noxius* |
| M8 | 4.1 | 6 | 4.1 | 5.6 | *Marasmius arboresis* |
| M9 | 23 | - | 20 | - | *Pogonomyces hydnoides* |
| M10 | 6 | - | 4.1 | - | *Cymatoderma elegans* |
| M11 | 5.9 | 8.8 | 5.5 | 8.2 | *Termitomyces clypeatus* |
| M12 | 6.5 | 10.9 | 5 | 7.9 | *Panus fulvus* |
| M13 | 6.7 | - | 4.9 | - | *Nothopanus hygrophorus* |
| M14 | 5.4 | - | 5 | - | *Podoscypha bolleana* |
| M15 | 3.4 | 3.5 | 3 | 3.2 | *Lactarius hygrophoroides* |
| M16 | 4.5 | 3.2 | 3 | 2.8 | *Filoboletus gracilis* |
| M17 | 3.3 | - | 3.2 | - | *Polyporus sp* |
| M18 | 22 | - | 20.0 | - | *Corilopsis occidentalis* |
| M19 | 3.5 | 4.7 | 3.1 | 4.4 | *Agaricus blazei* |
| M20 | 2.8 | 4.9 | 2.0 | 4 | *Coprinus sp* |
| M21 | 8.1 | - | 8.1 | - | *Microporus xanthopus* |
| M22 | 5.4 | 9.8 | 3.8 | 8.8 | *Termitomyces globulus* |
| M23 | 13 | - | 11.5 | - | *Polyporus dermoporus* |
| M24 | 16.8 | - | 16.5 | - | *Coriolus versicolor* |
| M25 | 5.6 | 5.6 | 4.4 | 5 | *Pleurotus tuber-regium* |
| M26 | 5.4 | 13 | 4.1 | 12.3 | *Agaricus sp* |

The high occurrence of these higher fungi may be as a result of availability of varieties of dead wood, litter of dead plant materials on forest floor and farmlands, coupled with other favourable climatic conditions that could easily aid spore dissemination and germination[11,15,16]. Their availability in Akoko land may also be linked to the ability of these mushrooms to metabolize cellulose and lignin that are present in different species of wood in typical this tropical rain forest[18,19]. Alofe *et al*[1], reported that mushrooms are the common saprophyte found on decaying deadwood trunk. Some of these organisms could also parasitize the living trees contributing to their death[9,24].

Two mushrooms (*Termitomyces clypeatus* and *Termitomyces globulus*, Plate 19*)* were found in this study to be associated with termite nests (TABLE 1). The genus *Termitomyces c*ould be differentiated from other agarics by the presence of pseudorhiza and it symbiotic association with termite nest. The sporophores of *T.globulus* were collected in July 2010 during the rainy season on the soil associated with termite nest. The pileus has light orange colour with 8-12cm in diameter. Initially, it may have convex structure. The gills attach directly to the stipe which is white in colour and possessed notch at the point of attachment. The stalk is about 7-9cm long and 1.3 in diameter. Spores are white, smooth, thick walled; ellipsoid and 5x 4µm. The stalk is having a long root-like structure which projects downward into the soil. *Termitomyces cleapatus* fruitbodies were collected under tree shade where they grow in their large numbers. This mushroom was also found to be associated with termite nest. It could be identified by its silky, greyish brown cap of about 8cm in diameter. It has a dark coloured gills, free white stipe with 10cm long the spores are smooth, thick walled and hyaline. The spore print was pinkish in colour

Wild mushroom species collected from different decaying wood were *Corilopsis occidentalis*, (Plate 10) *Daedalea sp* (Plate5), *Daldinia concentrica* (Plate 1*)*, *Fomes sp, Fomes noxius* (Plate 6), *Coriolus vesicolor, Cymatoderma elegans* (Plate 9), *Microporusxanthopus* (Plate18), *Nothopanus hygropharus* (Plate12), *Polyporus sp* (Plate16), *Polyporus dermoporus* (Plate 20), *Schizophyllum commune* (Plate 3), *Pleurotus tuber-regium* (plate 21*)*, *Pogonomyces hydnoides (*Plate 8) *and Podoscypha bollena* (Plate13).

*Corilopsis occidentalis* belongs to the order aphyllorophorales and family polyporacea. It is a common species found on the dead wood in Akoko land. The fruitbodies are coriaceous, corky and sessile. They are usually flabelliform although few collected sporophores are reniform. Pilus of this fungus are usually aplanate It possesses upward reflexed margin of 3-16 cm long and1-11cm wide. The upper surface of the cap is tomentose with yellowish beige or ochraceous brown in colour. It was found growing in abundance on the dead wood of *Theobroma cacao* and *Terminalia obovata*. Spore print was hyaline. *Daedalea sp* also belongs to the order aphyllorophorales and family polyporacea. It could be recognised easily by daedaloid hymenium. Pilus is sessile and sometimes penetrates into a stem like point of attachment. The carpophores may be white when young, but the colour changes to brown

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on maturing. *Daldinia cocentrica* is one of the common species found growing on the dead trunk of wood in Akoko land. It belong to the class Ascomycetes, order xylariales and family xylariacea[26]. The carpophores usually open through the surface of the dead wood which acted as a substratum. It is an interesting genus in that it forms large black hemispherical stroma with a zoonate inner tissue. The fruitbodies or stroma appears as hard hemispheral cushion up to 4cm in diameter on the dead trunk. The surface was somehow glossy. The spore print was green. Fruit bodies of *Pogonomyces hydnoides* were found growing on standing dead wood of *Samanea saman* They have bracket-type of fruitbodies which is usually black in colour. The carpophores were sessile, aplanate and reinform. Pileus was 3-15 cm long, 2-8cm wide and 0.5mm thick. The spores are smooth and hyaline. This higher fungus have been implicated in causing white decay of wood *of Myristica surinamensis*[26].

*Polyporus dermoporus* and other *Polyporus sp* were found on the bark of *Trema orienalis* and *Ceiba pentrada* respectively. They were identified by the presence of little hollow tubes on the lower surface of the cap. The fruitbodies are usually pleurotoid or with central stipe. The stipe is solid and sessile. The spores are usually hyaline and cylindrical. *Polyporus dermoporus* fruitbodies are usually white. Pilus is 4-7cm wide and 1-5mm thick. The spore print was white. The other *Polyporus sp* is a solitary type with one fruit body per log. The fruitbodies developed n the dry wood lying on the ground. The spores print was hyaline, smooth, ellipsoid and apiculate. *Panus fulvus and the other Panus sp* were found growing on partially buried wood. They may have variable characters but, they could be easily identified with the aid of funnel shape cap. Spore print of *Panus fulvus* was white, cap between 2-11cm. The stipe is darker than the cap and usually arises from pseudo sclerotium. *Panus sp* has cream spore print. The characteristics used in classifying other wood inhabiting fungi were represented on (TABLES 1 and 2).

Soil inhabiting species as obtained from these studies were *Coprinus sp, Marasmius arborescens* and *Marasmius zenkeri.M.arborescens* were found growing in their large numbers during early rain (May). The fruitbodies were small and inconscipious. The light yellow sporophores usually grow together in clusters. The cap was between 1-1.8 cm in diameter. The stipe is between 4-11cm long and the spore print was hyaline. *M.zenkeri* is a beautiful species collected on forest floors of Akoko land. Cap was between 3-10cm diameter. Stipe is between 12-17cm long with swollen base. Spore print was off white or light yellow, cylindrical and smooth. *Coprinus sp* was also collected from the soil. The gills of this fungus usually deliquesce on maturity. This species were found growing on forest litters. The carpophores were fragile. Cap was conical or bell shape. It was about 23-25cm in diameter. Spores print was dark brown or black (TABLES 1 and 2).

Figure 2 shows the proximate compositions of the four wild edible fungi analyzed. *Agaricus sp* contained the highest protein content (37.09%) followed by *Termitomyces globulus* (31.77%), *Termitomyces clypeatus* (19.82%) and *Pleurotus tuber-regiun* (12.14%). These results could be compared with the observations of other workers. Jose and Kayode[21], reported that *Termitomyces robustus* contained 33% protein, and Alector and Adetimirin[5] reported 33.8% of protein for this same mushroom. Gbolagade *et al*[15] recorded 28.1 and 34.1% for *T.microcarpus* and *T.globulus* respectively. Fasidi and Kadiri[12] also reported the protein contents of 9.47-19.05% in various *Agaricus* species analyzed from south western Nigeria. From Figure 2, it was observed that *Termitomyces globulus* had the highest crude fat value of 2.97% followed by *T. clypeatus* and *Pleurotus tuber-regium* while *Agaricus* sp had the least value (0.98%).

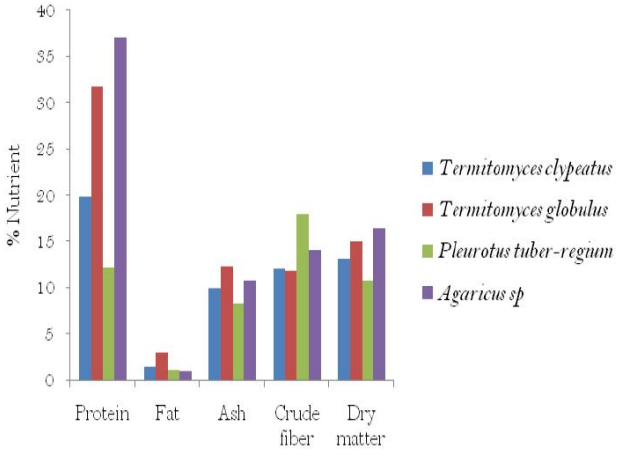


**Figure 2 : Nutrient composition of some edible mushrooms**

This agrees favorably with the reports of Fasidi[11] and that of Gbolagade *et al*[15] that mushrooms are

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virtually free of fat. No wonder they were recommended as an ideal food for the obese and people with high blood pressure[21]. With respect to ash content, *T. globulus* had the highest value (12.3%) followed by *Agaricus* sp and *Termitomyces clypeatus* while *P. tuber-regium* had the least value (8.31%). *P. tuber-regium* had the highest crude fiber (17.92%) followed by *Agaricus* sp and *T. clypeatus* while *T. globulus* had the least value (11.79%). The dry matter content was high in *Agaricus sp* (16.45%) followed by *T. globulus* and *T. clypeatus* while the least dry matter value was found in *P. tuber-regium* (10.74%). Similar observations were made for *Volvariella esculenta*[11].

Results on Figure 3 show the values for the macromineral compositions. Calcium content was highest in *Pleurotus tuber-regium* (0.19%) followed by *Agaricus* sp and *T. globulus* while *T. Clypeatus* had the least value of 0.02%. Fasidi and Kadiri[12], reported significant amount of calcium in wild edible mushrooms. *P. tuber-regium* had highest magnesium composition (1.5%) while *T. clypeatus* had the least (0.08%). *T. cypeatus* had the highest potassium composition (0.29%) while *P. tuber-regium* had the least (0.18%). Phosphorus composition was highest in *Agaricus* sp (0.92%) while it was least in *P. tuber-regium* (0.5%). Generally, there were low sodium content in all the mushrooms analyzed. From Figure 4, *Agaricus* sp had the highest value and *T globulus* had the least value of 0.01% while *Pleurotus tuber-regium and T. clypeatus* had the values of 0.052 and 0.023% respectively.

Figure 4 also shows micromineral composition. Iron content varied from *P. tuber-regium* with 0.050% to *T. clypeatus* with 0.01% Copper content ranged from *P. tuber-regium* (.026%) to *Agaricus* sp (.017%). The zinc content in *T. globulus, T. clyeatus, Agaricus* sp and *P. tuber-regium* were 0.38, 0.33, 0.28 and 0.14 % respectively. Also, *T. Clypeatus* had the highest value of manganese (0.67%) followed by *P. tuber-regium* (0.37%) and *Agaricus* sp (0.22%) while *T. globulus* had the least manganese content

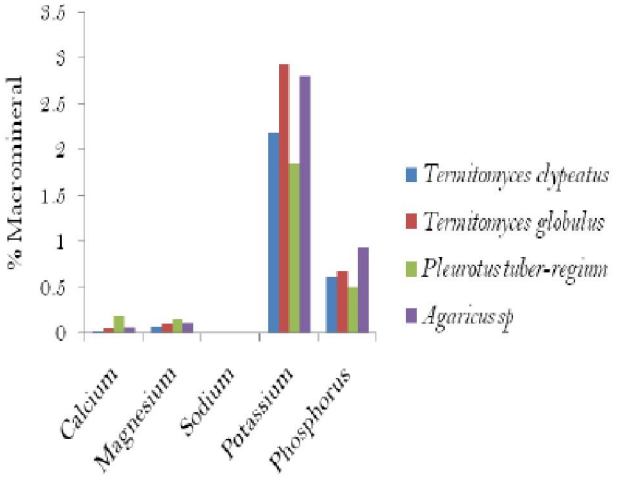


**Figure 3 : Macro minerals content of some wild edible mushrooms**

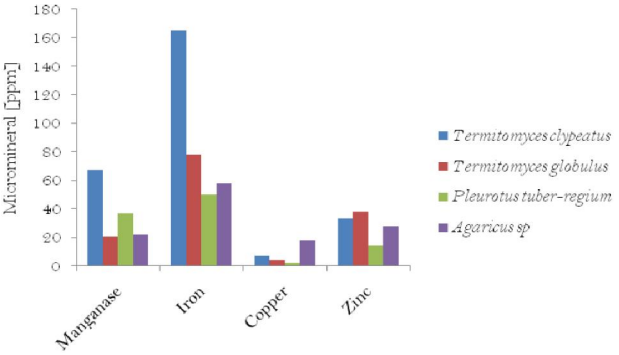


**Figure 4 : Micro minerals contents of some wild edible mushrooms**

**Plate 1 : Daldinia concentrica**

**Plate 2 : Panus sp**

**Plate 3 : Schizophyllum commune**

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Plate 4 : Marasmius zenkeri

Plate 5 : Daedalea sp

Plate 6 : Fomes noxius

Plate 7 : Marasmius arboresis

Plate 8 : Pogonomyces hydnoides

Plate 9 : Cymatoderma elegans

Plate 10 : Corilopsis occidentalis

Plate 11 : Panus fulvus

Plate 12 : Nothopanus hygrophanus

Plate 13 : Podoscypha bolleana

Plate 14 : Lactarius hygrophoroides

Plate 15 : Filoboletus gracilis

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Plate 16 : Polyporus sp

Plate 17 : Agaricus blazei

Plate 18 : Microporus xanthopus

Plate 19 : Termitomyces globulus

Plate 20 : Polyporus dermoporus

Plate 21 : Pleurotus tuber-regium

## CONCLUSION

Results of mineral compositions of the four edible mushrooms selected for these studies clearly indicated their potential as an article of food. As it was observed in these studies, protein value of the four mushrooms could compare favourably with those reported for other vegetables. In general, the results of nutritionally valuable minerals showed that the four edible mushrooms species are rich sources of calcium, magnesium, iron, potassium, manganese but low in low in sodium, and copper. This is in agreement with the report of analysis of some common mushrooms by other authors[2,4,15].

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