

Morphology and Taxonomy of the genera *Stropharia* and *Pholiota* (strophariaceae, agaricales) from Ahmadu Bello University main campus, Zaria.

Ali, B. D.

Department of Biological Sciences, Adamawa State University, Mubi
P.M.B. 25, Mubi, Adamawa State-Nigeria.
lammababs@yahoo.com
08064745484

Abstract

Four species belonging to two genera, *Stropharia* and *Pholiota* in the family Strophariaceae, were studied and identified using conventional keys. These include *Pholiota spumosa* (Fries) Singer, *Stropharia coronilla* (Bull. Ex DC.: Fr.) Quel, Mem. Soc. Emul. Montbeliard., *Stropharia spp* (Fr.) Quelet and *Pholiota destruens* (Brond.) Gillet. All species are described in detail, and their taxonomy discussed. These species are recorded for the first time from Northern Nigeria. The studied species exhibited high morphological and anatomical diversity. The specimens are deposited in the herbarium of the Department of Biological Sciences, Ahmadu Bello University, Zaria.

Keywords: Strophariaceae , Agarics, Taxonomy, Description, *Stropharia*, *Pholiota*.

Introduction

The agarics or gilled mushrooms are by far the most familiar, numerous and complex group of fleshy fungi (Arora, 1986). The family Strophariaceae consists of saprophytic mushrooms with brown to purple-brown or purple-black spores and attached lamellae (gills). A veil is usually present, but does not necessarily form an annulus (ring) in the stalk. The lamellae are not normally decurrent as in *Gomphidius* and *Chroogamphus*, nor are they usually free as in *Agaricus*. The mushrooms in this family also share several anatomical (microscopic) characteristics: the pileus (cap) cuticle is usually filamentous rather than cellular and the spores are smooth and often with a germ pore (Arora, 1986, Singer, 1986; Watling and Gregory, 1987).

Strophariaceae is recognized by four genera all of which integrate to some extent; *Pholiota* has dull brown to rusty-brown spores

and is consequently placed in Cortinariaceae by some mycologists; *Stropharia Psilocybe* and *Naematoloma* have deep brown to purplish or black spores and are sometimes placed together in a single giant genus, *Psilocybe*. Singer (1986) recognized 20 species worldwide but Hawsworth *et al.* (1995) attributed 15 species for the genus. A checklist by Wasser and Grodzinskaya (1996) listed 111 names in *Stropharia* of which 28 are currently in use. Cortez and Silveria (2008) described 12 species of *Stropharia* in which three species were new records in Rio Glande de Sul State, Brazil.

The genus *Pholiota* is the largest genus of brown-spored, wood inhabiting agarics. The basidiomata is usually larger and fleshier than in *Galerina* and *Tubaria* having a vein in young specimens and the stalk is well-developed and central to somewhat off-centre. A few *Pholiota* are terrestrial, and these are more difficult to distinguish in the field, but the presence of viscid or slimy pileus, frequently slender stalk

and sometimes clustered growth habit are outstanding features of this genus. Microscopically, they are distinct by virtue of their smooth spores (Arora, 1986). In their monograph on North American Pholiotas, Smith and Hesler (1968) recognized over 200 species.

In Nigeria, there is paucity of reports in the published literatures on the genera *Stropharia* and *Pholiota* despite all efforts made by scientists in the taxonomy of mushrooms (Zoberi, 1978; Osemwegie *et al.*, 2009, Ali *et al.*, 2010a, Ali *et al.* 2010b; Ali and Khan, 2011). Therefore, this research was designed to study the morphology and anatomy of some species in the family Strophariaceae with a view to ascertain their taxonomic status.

Materials And Methods

Mushroom Collection

The mushrooms were collected from the wild within Ahmadu Bello University Main Campus, Zaria, during rainy season. The basidiomatas (fruiting bodies) of the mushrooms were photographed using digital camera. During the collection, hand trowel was used to dig up the base of mushrooms from the soil. The habitat, locality, and date of collection were recorded in a field notebook. The collected mushrooms were carefully kept in cellophane paper bags and labeled accordingly. Basket was used to convey the mushrooms to the laboratory for morphological and anatomical studies.

Both morphological and anatomical characters were studied using the methods proposed by Gillman (1978), Arora (1986), Kenderick (2000), and Kuo (2004).

Morphological studies

Pileus Features

Pileus features including size, colour, texture, shape, margin, and edge were examined and recorded. The sizes of the pilei were also measured with a metre rule and recorded.

Stipe Features

Important characters of the stipe such as the texture, density, dimension, and configuration were recorded.

Lamellae Features

Lamellae were observed to record the colour, density, attachment to the pileus, texture, and edge using hand lens.

Annulus and Volva

Annulus and volva were observed to note whether present or absent. Where present, their various shapes were recorded.

Colour of Latex

The lamellae were sliced slightly using razor blade to note the colour of the latex exuding from the cut surfaces. Pilei and stipes were also bruised to record any change of colour in the area.

Anatomical Studies

Spore prints were obtained from the mushrooms following the procedures suggested by Christensen (1982). Colour of the spore prints were observed and noted under incandescent light. Spores taken from the spore prints were mounted in Melzer's reagent and then observed under the light microscope to note various characters such as shape, surface, wall thickness, and colour. Measurement of spores' sizes was carried out under the microscope using micrometer. Ten mature spores were measured and the range of lengths and widths of spores were recorded following the method by Kuo (2004).

Basidia, Cystidia, and Lamellae Trama

A thin cross section of the lamellae was made using a microtome to reveal the hymenial layer of both sides of the trama. The arrangement of the lamellae trama was observed under the microscope to note shapes of the basidia and cystidia. The number of basidiospores borne on the basidium and their arrangement were observed and recorded.

Taxonomic Studies

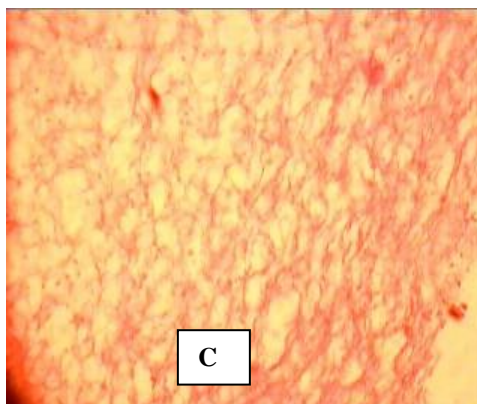
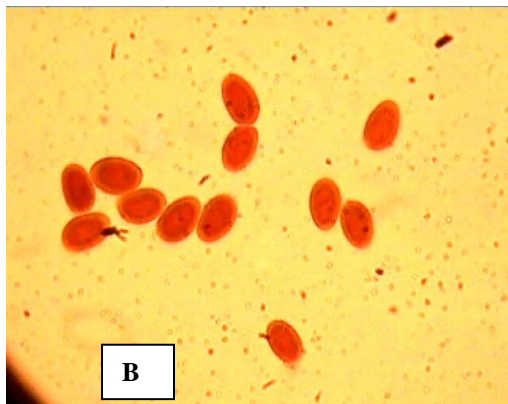
After recording the morphological features of the collected mushrooms, they were compared with documented species using the keys of Smith (1971), Zoberi (1972), Gillman (1978), Kerrigan (1986), Arora (1986), Kenderick (2000), and Kuo (2004) to ascertain their taxonomic positions.

RESULTS

Pholiota spumosa (Fries) Singer

Habit and Habitat gregarious, growing on buried wood. *Pileus* 3.0-6.0cm broad, pinkish when young to dark red when matured;

bell shaped, convex and slightly umbonate, smooth; edge entire. *Lamellae* flesh pinkish to dark colour, close to nearly crowded; adnate, thick, soft; edge entire. *Stipe* 6.0-7.0cm long, 0.4-0.8cm thick, greyish to light brown; equal, centric to off-centre, moist, and partially hollow. *Annulus* present at young stage but absent in old specimens. *Spore print* dark brown. *Basidiospores* 5.0-6.75 x 2.5-3.0 μ . *Spore characteristics* elliptic, smooth, slightly thick-walled, dextrinoid. *Basidia* with four basidiospores. *Lamellae trama* interwoven. *Pileus cuticle* filamentous.



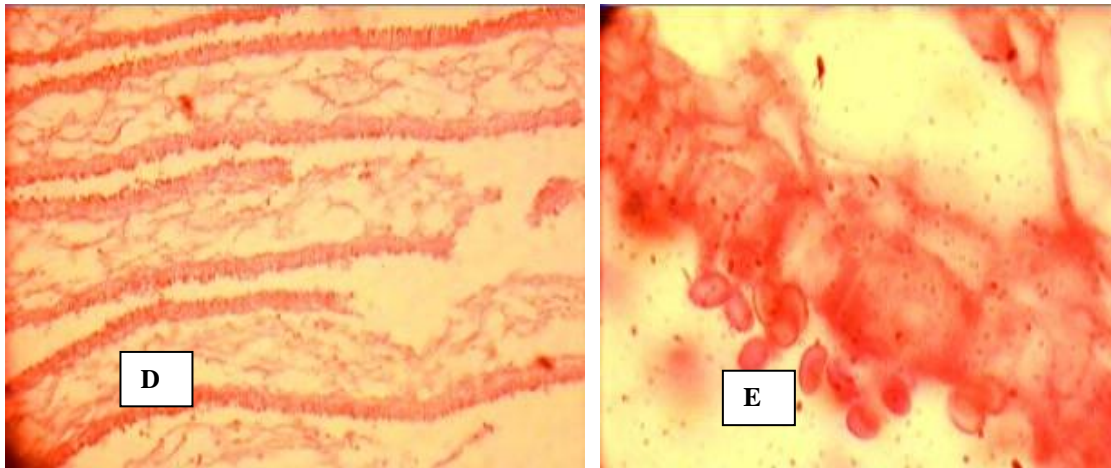
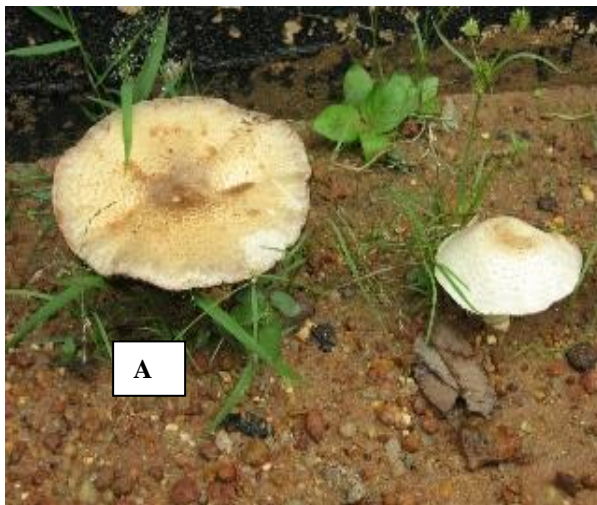


Plate 1: A, Basidiomata of *Pholiota spumosa*.
 B -spores in Melzer’s reagent x 1000, C- filamentous cuticle x 100,
 D-interwoven lamellae trama x 100, E-basidium with four basidiospores x 1000.

Stropharia coronilla (Bull. Ex DC.: Fr.) Quel,
 Mem. Soc. Emul. Montbeliard

Habit and Habitat scattered on soil. *Pileus* 9.0-9.6cm broad, light brown, granulose, convex with slight depression when young, then flat with upturned margin covered with somewhat yellowish scales which occurred in concentric rings; edge entire. *Lamellae* flesh dark brown, close, intermediate, adnexed, thick;

edge entire. *Stipe* 6.0-7.0cm long; 1.0-1.5cm thick; white, hollow, centric, sub-bulbous base; smooth but with dark scales coating on the embedded portion, snapped easily at the point of attachment to the pileus. *Annulus* striate not prominent, superior. *Spore deposit* dark brown to black. *Basidiospores* 5.0-7.5 x 3.0-4.75µm. *Spore characteristics* elliptical, smooth, inamyloid with apical pore.



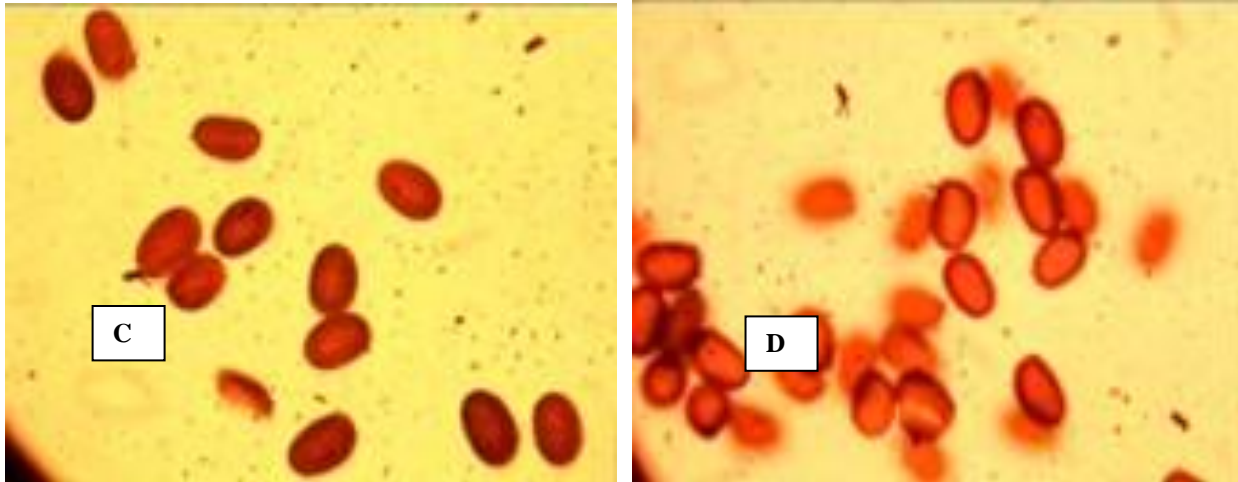


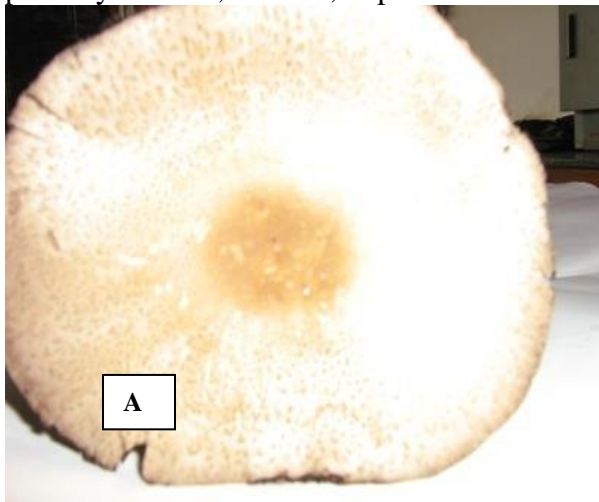
Plate 2: A, B, Basidiomata of *Stropharia coronilla*.
C-smooth elliptic spores in Melzer's reagent x 1000, **D**-spores in water x 1000.

***Stropharia* sp.**

Habit and Habitat solitary, found growing on rotten leaves. *Pileus* 11cm broad, brown, convex with incurved margin, soft and smooth; centre reddish; edge rimose. *Lamellae* flesh pink to dark brown, close, free, intermediate, thin and dried; crenate. *Stipe* 9.0cm long; 1.5 thick, pinkish to brown, partially hollow, centric, tapered towards the

base. *Annulus* collapsed on the stipe. *Volva* absent.

Spore print dark brown. *Basidiospores* 5.0-8.0 x 2.5-5.0µm. *Spore characteristics* elliptic, smooth, thick-walled, with a germ pore. *Basidia* not seen. *Lamellae trama* interwoven *Pileus cuticle* filamentous *Cystidia* lance-shaped.



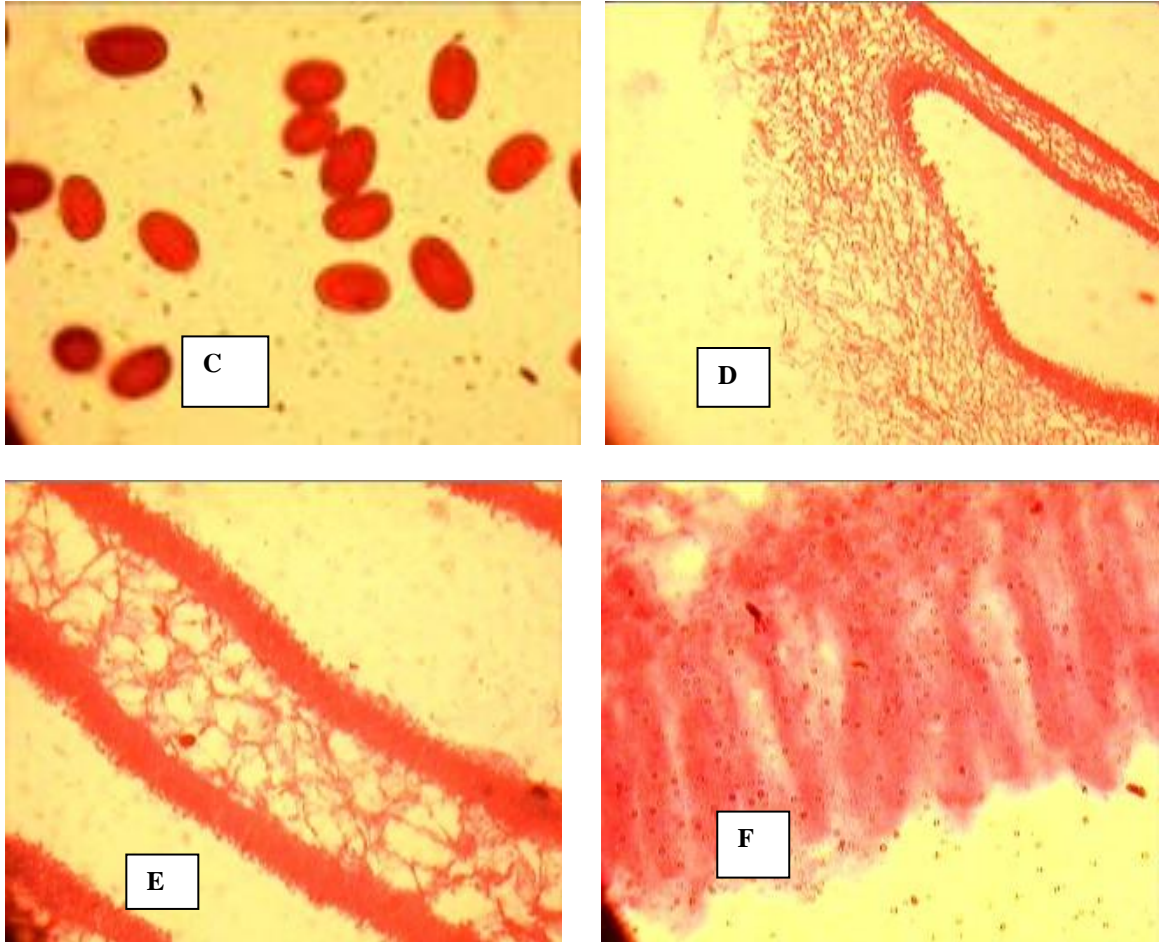


Plate 3: A, B, Basidiomata of *Stropharia* sp.

C-inamyloid spores in Melzer's reagent x 1000, **D**-filamentous pileus cuticle x 40
E-interwoven lamellae trama x 400, **F**-cystidia x 1000.

***Pholiota destruens* (Bond.) Gillet**

Habit and Habitat solitary growing beside *Gmelina aborea* tree. *Pileus* 9.6cm broad; light brown, fibrillose to scaly surface, convex to plane, margin shape slightly upturned, edge entire. *Lamellae* flesh brown, close, intermediate, free, and thin. *Stipe* 9.0cm

long; centric, light brown, partially hollow, and filled with white cottony materials, bulbous base. *Spore print* purple brown. *Basidiospores* 4.5-7.5x2.5-4.25 μ m. *Spore characteristics* smooth, elliptical, slightly thick-walled, inamyloid.

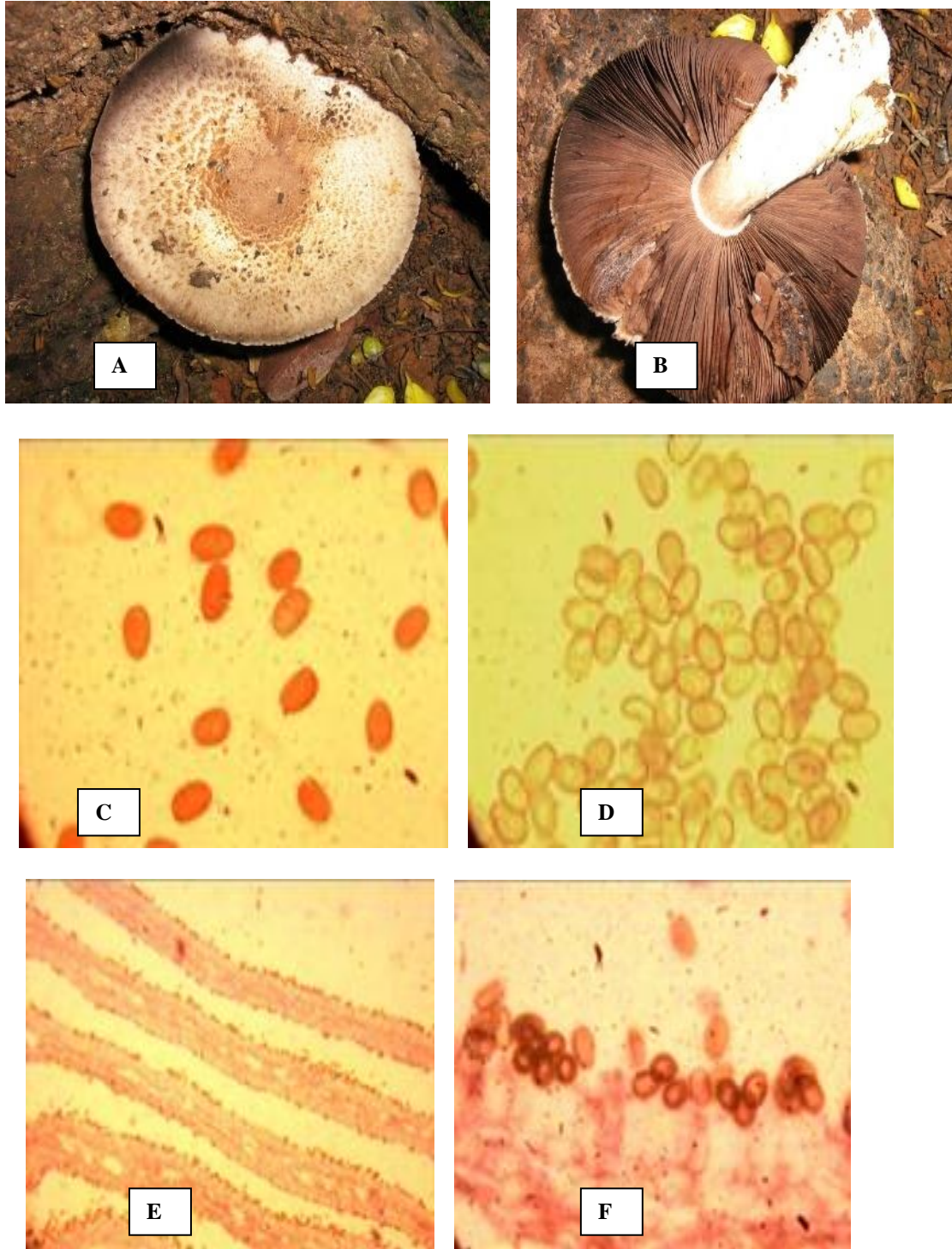


Plate 4: **A, B**, Basidiomata of *Pholiota destruens*
C-spores in Melzer's reagent x 1000, **D**-spores in water x 1000, **E**-interwoven lamellae trama x 100, **F**-basidia with four basidiospores x 1000.

Discussion

Pholiota spumosa (Fries) Singer

Both macroscopic and microscopic descriptions recorded in this collection are in conformity with the features recorded by Arora (1986). This collection, however, differs in having short elliptical dextrinoid spores (6.75µm) compared with the length of 9µm as reported by Arora (Plate 4 C). The lamellae rot away quickly and stipe equal in configuration. This species was found growing in turf on buried wood. *Pholiota spumosa* differs from other similar species in having greenish-yellow flesh and lamellae; a viscid to slimy pileus and an evanescent veil. The veil is not slimy as in the *P. velaghitinosa* group (Arora, 1986).

Stropharia coronilla (Bull. Ex DC.:Fr.) Quel, Mem. Soc. Emul. Montbeliard.

This collection was compared with the details provided by Arora (1986) and was confirmed as *Stropharia coronilla*. However, it differs in having a larger fruit body, stipe narrowing sharply above the superior striate annulus, base deeply imbedded in the substratum leaving a reddish scaly mark on the embedded portion. Spores in this collection are less broad 7.5µ (Plate 2C) in comparison with the broad of 11µ recorded by Arora (1986). This species is often mistaken for *Agaricus*, but has adnexed rather than free lamellae and a frequently grooved or striate annulus (Cortez and Selveria 2008). It is shorter in stature than *Stropharia semiglobata* (Batsch)Quel the annulus is mois configuration and not viscid. *Stropharia bilamellata* differs in having deeply grooved annulus while *S. hardii* is slightly larger and grows in grass as well as in woods; veil disappeared in age and has smaller spores (Arora, 1986).

Stropharia sp.

This collection is in complete conformity with the morphological details given by Arora (1986) and was identified as *Stropharia* sp. The distinguishing characters of

this genus are the presence of a membranous to gelatinous annulus, purplish brown spore print, smooth basidiospores with a thick-wall and presence of germ pore (Plate 3C). Another outstanding feature of this genus was the presence of filamentous pileus cuticle (Plate 3D).

Pholiota destruens (Bond.) Gillet

This collection was compared with the morphological features by Arora (1986) and was found to have the same macroscopic and microscopic features, but differing in having entirely smooth stipe and the spores lacking apical pores (Plate 4 B&C). The pileus in this collection was covered with fine fibrils instead of scales (Plate 4A).

Conclusion

The findings revealed morphological diversity among the studied species. The species displayed varying spores' sizes and characteristics. However, the spore prints were trendy from brown to dark brown. The variations in the morphological and anatomical characters recorded in this finding as compared to the documented species could be due to geographical locations and climatic conditions prevailing in these areas.

References

- Ali, B.D., Khan A.U.; Dangora, D.B and Mu'Azur S.A. (2010a). A survey of Agaricales in Ahmadu Bello University Main Campus, Zaria. *Niger. J. Bot.*, **23** (2) 65-74.
- Ali, B.D., Khan, A.U., Dangora, D.B and Wuyep, P.W. (2010b). The Agaricaceae of Northern Nigeria I: Their Morphology and Taxonomy. *African Journal of Biosci.*, **3** (2): 13-19.
- Ali, B.D and Khan, A.U. (2011). Morphology and Taxonomy of some species of Agaricales from Northern Nigeria. *International Journal of Biological Science*, **3** (1): 119-125.

- Arora, D. (1986). *Mushrooms Demystified. A comprehensive Guide to the fleshy mushrooms*. 2nd edition, Ten Speed Press, Berkeley. 986.
- Christensen, C.M. (1982). *Edible mushrooms*. University of Minnesota press Minneapolis, 118.
- Cortez, V.G. and Silveria, R.M.B. (2008). The agaric genus *Stropharia* (Strophariaceae, Agaricales) in Rio Grande do sul State, Brazil. *Fungal Diversity*, **32**: 31-57.
- Gillman, L. (1978). Identification of common poisonous mushrooms. In: Rumack, B. H. and Salzman, E. (Ed), *Mushroom poisoning: Diagnosis and treatment*, CRC Press, Inc, Florida. 27-57.
- Hawksworth, D.L.; Kirk, P.M.; Sutton, B.C. and Pegler, D.N. (1995). *Ainsworth & Bisby's Dictionary of the Fungi*. 8th ed. Surrey: International Mycological Institute/CABI Publishing.
- Kenderick, B. (2000). *The fifth Kingdom*. 3rd edition, Focus Publishing R. Pullins Company, Newburyport MA USA, 373.
- Kerrigan, R.W. (1986). *The Agaricales (Gill fungi) of California*. Mad River Press, Eureka, CA, 400.
- Kuo, M. (2004). The gilled mushrooms (Agaricales). Retrieved from the *Mushroomexpert. Com.* website: <http://www.mushroomexpert.com/agaricales.html>
- Osemwegie, O.O., Okhuoya, A.J and Omorusi, I.V. (2009). Ecological Diversity of Macrobasidiomycetes in rubber research Institute of Nigeria, Iyanomo, Edo State. *Niger. J. Mycol.*, **2**(1): 23-40.
- Smith, A.H. and Hesler, L.R. (1968). *The North American Species of Pholiota*. Monticello: Lubrecht & Cramer, 402p.
- Singer, R. (1962). *The Agaricales in modern Taxonomy*. 3rd edition. J. cramer weinham, 912.
- Singer, R. (1986). *The Agaricales in Modern Taxonomy*. 4th ed. Koeltz Scientific Books, Koerugs, W. Germany, 1069.
- Smith, A.H. (1971). *The mushroom hunter's field Guide*. University of Michigan Press, Michigan, 264.
- Wasser, S.P. and Grodzinskaya, A.A. (1996). Contributions to the taxonomy of the family Strophariaceae Sing. Et. A.H.Sm. (Higher Basidiomycetes). In: Wasser S.P. (ed). *Botany and Mycology for the Next Millenium*. Kholodny Institute of Botany/National Academy of Sciences of Ukraine. Kiev: 372-405.
- Watling, R. and Gregory, N.M. (1987). *British fungus flora 5. Strophariaceae and Coprinaceae*. P.P. Edinburgh: HMSO, Royal Botanic Gardens, Edinburgh.