A TAXONOMIC REPORT OF SPECIES OF MYXOMYCETES- GENUS PHYSARUM PERS. FROM NIGERIA

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ABSTRACT
The present report is a continuation of a desire to upgrade the study of Myxomycetes in Nigeria to world standard. The species of Myxomycetes being reported here are in the genus Physarum. It is the largest genus among the genera of Myxomycetes and it is of the order Physarales. The six species reported are, Physarum leucopus Link; Physarum Melleum (Berk. & Brooms) Massee; Physarum mukerjii Ejale sp. nov. Physarum murinum Lister; Physarum mutabile (Rost.) G. Lister; and Physarum nucleatum Rex. One of the species is being reported as new to world record of the species of Myxomycetes.

Keywords: Myxomycete, Physarum, Taxonomy, Nigeria

INTRODUCTION
Research work on Myxomycetes in Nigeria is very scanty. The first report of the species of Physarum from Nigeria were by Ing (1964) and Ing & McHugh (1968). Farquharson and Lister began the report of myxomycetes from southern Nigeria as early as 1916. Their pioneering work attracted Ing (1964); Ing and Mchugh (1968), whose work led to the publication of a checklist (without taxonomic description) of myxomycetes from Nigeria in which 69 taxa were reported. No further research work has been done on the myxomycetes until recently. In recent times the study of myxomycetes from Nigeria has been receiving more attention with the contributions of Ejale (1991); Ejale and Gill (1991, 1992, 1995 and 1999); Ejale (2005); Ejale and Orumwense (2006a and b and 2007); Ejale and Oyinbe I. Henry (2007); Ejale (2010); Ejale and Orumwense (2011a and b); Ejale and Ihayere Celestina (2012); Ejale et al. (2012a) and Ejale, et al., (2012b).
The genus *Physarum* is a member of the myxomycetes or acellular slime moulds. It has the largest number of species among the myxomycetes. The myxomycetes have a peculiar nature. They have the characteristics of both animals and plants at different stages during their life cycle. They are sometimes called plasmodial or acellular slime moulds. Myxomycetes is their taxonomic class name. The myxomycetes (plasmodial slime moulds) are fungus-like eukaryotes. They are the largest Subclass of mycetozoans. They are traditionally studied by Botanists especially Mycologists. They are believed to have evolved independently of the fungi from simple flagellate organisms. The vegetative phase of myxomycetes consists of a slimy, naked mass of protoplasm with many nuclei called plasmodium. It is a motile protoplasm that lacks a cell wall. This has made the myxomycetes a valuable tool for research by present day scientists. The plasmodium of myxomycetes is a great asset to researchers involved in the study of the processes of life at the cellular level because it is just a mass of protoplasm without a cell wall. Examples are cancer research and genetics, biochemistry, biophysics, and easy tools in the study of fundamental biological processes such as biological control agents (Ejale and Orumwense, 2006 and 2007). The dual (plant and animal) nature exhibited by the myxomycetes seemingly made them to defy classification either as plants or animals. (Martin and Alexopoulos, 1969; Alexopoulos and Mims, 1979; Farr, 1976; Nannenga – Bremekamp, 1991; and Stephenson and Stempen, 2000).

Their (myxomycetes) fructifications are from sporangiate to plasmodiocarpous. They are rarely almost aethalioid; peridium single or double, calcareous; stalk, when present, is usually tubular and translucent, or stuffed with lime or dark amorphous materials, and other times with lime on the exterior surface only; the capillitium is a network of hyaline tubules connecting calcereous nodes, attached to the base and to the peridium; lime is present in the peridium, capillitium and stalk in the form of amorphous granules, rarely subcry-stalline; spores are black or dark brown in mass, violet-brown or violaceous by transmitted light. This present study is a continuation of earlier work aimed at updating the taxonomic studies of Nigerian myxomycetes.

**MATERIALS AND METHODS**

Collections of Myxomycetes were made during the rainy season (July-September) around Benin City (6º20.022N 5º36.009E) from dead and decaying plant materials in shady places. Identification key, preservation, and presentation of results (data) are in accordance with Martin and Alexopoulos (1969), Lakhanpal and Mukerji (1981), and Martin et al (1983), Ejale and Gill (1991, 1992, 1995, 1999).
The drawings were made using ‘Abbe’ Drawing Apparatus (Plate 1).

The photomicrographs were done with Leitz (Ortholoz) Wetzlar (Germany) fitted with an automatic 35mm camera attachment and oil immersion, phase contrast objective (x40), and a compensation ocular (x12.5). Kodak and IIIford high contrast copyfield films were used.

Colour description of the various parts of the taxa was in accordance with the Mycological colour chart (Rayner, 1970) [Plate 2]. The colour chart provides information on the exact colour in nature, of the various parts (spores and capillitia etc.) being described, and it (colour) is of taxonomic importance. Each colour in the colour chart has a code.

Plate 1 Camera lucida (Abbe’s drawing apparatus)
Plate 2: Mycological colour chart (Rayner, 1970)
The presentation of results is in accordance with Martin and Alexopoulos (1969), Lakhanpal and Mukerji (1981), Martin et al. (1983), Harold et al. (2008). Under each species the following data are provided: Current nomenclature with author’s full reference and synonyms (if any); A concise diagnostic description of fructification, sporangium and stipe. When spores are borne externally, the sporangiophore is described. In the endosporous species, the description of fructification includes: morphology of the fruiting body; peridium characteristics; manner of dehiscence (if observed); characteristics of columella or pseudocapilitium; and spores. The description of stipe includes its morphology and hypothallus; type of locality; collection number; habitat; and distribution; and comments on taxonomic affinities and phenotypic variability of the taxon (if any). The description of species reported as new is done in Latin and English as required by the International Code of Botanical Nomenclature. Confirmations of identifications were made in the laboratory of Prof. T.N. Lakhanpal of Himachal Pradesh University Shimla, India. Voucher specimens are in the Department of Plant Biology and Biotechnology, University of Benin, Benin City, Nigeria. Duplicates have been deposited at the Commonwealth Mycological Institute Kew Surrey, England for their record.

RESULTS AND DISCUSSION

*Physarum leucopus* Link. *Ges. Nat. Freunde Berlin* Mag. 3: 27. 1809. (Fig. 1 and Plate 3)


**Description:** Sporangia gregarious, stipitate, globose, white (RAL9010), 0.4mm in diameter; peridium calcareous, the lime in small, frosty particles; stalk white (RAL9010), calcareous, brittle, tapering upward, about equal to the length of sporangium; columella absent, sometimes present as a short conical protuberance; capillitium rather lax, the nodes large, angular, white (RAL9010), connected by long hyaline threads, sometimes massed in centre forming a pseudo-columella; spores black (RAL9011) in mass, pale brown (RAL 8002) by transmitted light, distinctly warted, 8.4 µm in diameter.

**Type Locality:** Opoji; Habitat: Dead twigs;

**Collection No:** E880153;

**Distribution:** Cosmopolitan.

**Comments**

This Nigerian collection of *P. leucopus* resembles the type description in every respect. It is characterised by white
Fig. 1  *Physarum leucopus* Link  

a) Fructifications at various stages of dehiscence, x 25;  
b) Large lime nodes, capillitium threads and spores, x 300;  
c) Fructifications (x5), lime nodes and spores, x 250  
i  Stipe;  
ii Inner peridium;  
iii Outer peridium;  
iv Habitat;  
v Spore;  
vi Capillitium thread;  
vii Lime node
Fig. 2 *Physarum Melleum* (Ber. & Br.) Massee
a) Fructification at dehiscence, x 25;  b) Spores, x 300;  c) Fructification before dehiscence, x 25;  d) Lime nodes, capillitium threads and spores, x 260;  e) Lime nodes, capillitium threads and spore, 250 i Lime granule;  ii Stipe;  iii Sporangium;  iv Lime node;  v Spore;  vi Capillitium thread
Fig. 3 Physarum mukerji Ejale sp. Nov.
a) Fructifications showing lime crusts on peridium, x 25; b) Spores, x 300;
c) Stipe with a very prominent and expanded columella, x 260; d) Capillitium threads, lime nodes and spores x 260; i) Lime granule; ii) Peridium; iii) Stipe; iv) Columella; v) Spore; vi) Lime granule; vii) Capillitium thread
Fig. 4  *Physarum murinum*. Lister
a) Lime nodes of various sizes, capillitium threads, spores, and remnants of peridium attached to stipe, x 260;
(b) Mature fructification x 100; (c) Fructification spores, lime nodes, and capillitium threads, x 250; (d) Spores, capillitium threads and lime nodes x 300.
i Lime cake; ii Stipe; iii Part of peridium; iv Spore; v Lime granule; vi Capillitium
Physarum mutabile (Rost.) G. Lister
a) Sessile fructification on the habitat, x 25; b) Lime nodes, capillitium threads and spores x 25; c) Lime nodes, capillitium threads and spores, x 25
i aetheliate fructification; ii Habitat; iii Capillitium thread; iv Lime granule; v Spore; vi Part of peridium
RAL9010), short stipe, equal in length to the sporangium which is also white (RAL9010). The spores are distinctly warted. The capillitium is composed of large angular nodes connected by hyaline threads. This is the first record of this species for W. Africa.

**Physarum melleum** (Berk. & Brooms)-Massee.(Fig.2 and Plate 4)

**Synonyms:** Didymium chrysopeplum Berk, & Jour. Linn. Soc. 14. 83. 1873.
Physarum schumacheri var. melleum (Berk. & Br.) Rost., Mon. App. 7. 1876.
Physarum kalchbrenneri Masses, Mon. 297. 1892.

Sporangia gregarious, stipitate, rarely sessile, globose or somewhat flattened below, 0.4cm in diameter, brown (RAL 8002); peridium rugose, encrusted with lime, persistent below; stalk cylindrical, tapering from base to top, opaque, brown (RAL 8002), furrowed, calcareous, short, a little longer than sporangium, sometimes equal to the diameter of sporangium; columella small, conic; capillitium abundant, the nodes large, angular, yellowish green (1005); hypothallus white (RAL 9010) or colourless, spores dark (RAL 8022 ) in mass, brown(RAL 8002) in transmitted light, minutely warded, 8.0 µm in diameter.

**Type Locality:** NIFOR;

**Habitat:** Dead twig of a tree (an angiosperm);

**Collection No:** E89033; **Distribution:** Cosmopolitan.

**Comment**
The present Nigerian collection of *P. melleum* is characterised by having a rusty brown (RAL 8002) fructification and a sporangium of 0.4mm in diameter. The peridium is encrusted with white (RAL 9010) lime granules. The sporangium has a columella although small. The presence of small columella was reported by Martin and Alexopoulos (1969) and Lakhanpal & Mukerji (1981). Farr (1959) recorded obscure columella in a collection from Liberia. The present report is a new record for Nigeria.

**Physarum mukerjii** Ejale sp. nov. (Fig.3 and plate 5).

**Latin description**
Sporangis, glogbosis, stipitatis, atruter gregariis, vel dissipatis, 0.3mm – 0.4mm diam. Albus) – griseis (RAL 1013; peridio brunneus (RAL 8002) duplex, albus(RAL 9010) crystallinis calcareis minutis porcatis praedito, interior strato persistentii, membra-naceus, peridio, peristens irregulares, cupulatos stros tenui; stipute brevis erectus vel leviter flexus, leavis; columella distinctus, conic capillitio at angularis et rotundus ramosis anastomosantibus brunneus (RAL 8002) filamentis; sporis globosis, brunneus (RAL 8002) in uno latere, 12.0um diameter.

**Description:** Sporangia gregarious or scattered, short-stipitate, globose, 0.3mm – 0.4mm in diameter, whitish grey (RAL 1013); peridium
double, the outer layer brown (RAL 8002), covered with white (RAL 9010) lime granules, the inner layer membranous, the lower portion tending to persist as a more or less irregular cup; the stalk short, equal in length to diameter of sporangium, occasionally slightly longer, erect sometimes slightly bent, smooth; columella prominent, conical, capillitium composed of angular and rounded granules linked by brownish (RAL 8002) threads, 2.0um in diameter; spores globose, 12.0 µm in diameter, brown (RAL 8002) by transmitted light.

The locality: Opoji; Habitat: Dead twigs of angiosperm; Collection No: E89032

**Distribution:** Nigeria.

**Comments**

Physarum mukerjii Ejale sp. nov. is easily recognised by its fructification which consists of a brown (RAL8002) globose sporangium and a whitish (RAL 9010) stalk. White (RAL 9010) distinct granules of lime cover the peridium. The columella is distinct and conical. The spores of P. mukerjii are relatively large (12.0 µm in diameter) compared to spores of other species of Physarum most of which are 9.0um – 10.0um in diameter. This species is a new addition to the genus.

**Physarum murinum** Lister Mycet. 41. 1894. (Fig.4 and plate 6)


**Description:** Sporangia stipitate, gregarious, globose, about 0.5mm in diameter occasionally sessile or plasmodioc-arpous, grey (RAL7036); peridium membranous, encrusted with a layer of white (RAL 9010) lime granules; stalk cylindric, grey (RAL7036), calcareous, equaling or exceeding the sporangium, hypothallus inconspicuous; columella absent, capillitium dense, hyaline brownish (RAL 8002), angular nodes usually small; spores dark brown (RAL 7013) in mass, light brown (RAL 7038) by transmitted light, minutely warty, warts sometimes in clusters, 8.4 µm in diameter.

**Type Locality:** NIFOR;

**Habitat:** Frond of Rosystonia reqia (O.F. Cook);

**CollectionNo:** E89029;

**Distribution:** Netherlands, Sweden, Scotland, Nigeria.

**Comments**

This Nigerian population of Physarum murinum A. Lister differs from type description in the absence of columella and in having a grey (RAL7036) stipe. In the type description the stipe is pale brown (RAL 1015). Martin and Alexopoulos (1969) commented on the variable nature of the species. The
Fig 6  *Physarum nucleatum*  Nucleatum Rex
a) Dehiscing fructification, x 25;  b) Lime granules in groups and capillitium thread, x 260;  (c) Spores, x 1,300;  d) Young fructifications, x 5;  (e) Capillitium threads, lime granules and spores, x 250.
i Peridium;  ii Lime groups;  iii Stipe;  iv Spore;  v Hypothallus
Plate 3a Photomicrograph of the fructification of *Physarum leucopus* (x15) with a sporangium (a) and a stipe (b).

present report is the first from W. Africa.

*Physarum mutabile* (Rost.) G. Lister, in Lister, Mycet ed. 2.53. 1911 (Fig.5 and Plate 7)

**Synonyms:** *Crateriachea mutabilis* Rost., Mon 126. 1874.

*Didymium neapolitanum* Ces, in Rab-Wint., Fungi Eur. 2675. 1881.

Plate 3 b is a photomicrograph of the spores (x350) [c] and capillitia (x350) [d].


**Description:** Sporangia erect-cylindric, 0.27mm x 0.42mm, sessile, grey (RAL 7036); peridium thin, wrinkled, bearing uniform sometimes squamulose lime deposits; capillitium intricate, persistent, somewhat elastic, the nodes white (RAL 9010), varying in size, spores black (RAL...
Plate 4a: Photomicrograph of part of sporangium (a); and spores [x350] (b) of *Physarum melleum* (BER. & BR.) MASSEE

Plate 4b: Photomicrograph of fructifications (x10) of *Physarum melleum* (BER. & BR.) MASSEE on a substratum.
Plate 5a: Photomicrograph of fruitification (x10) of Physarum murkejii Ejale (sp. nov) with Sporangium (a) and stipe (b).

Plate 5b: Photomicrograph of part of fruitification of Physarum murkejii Ejale (sp. nov) with spores (a) lime granules (b) and peridium (c).
9011) in mass brown (RAL 8002) by transmitted light, spinulose, 6.7µm in diameter.

**Type Locality:** Ekpoma;
**Habitat:** Unidentified dead twigs;
**Collection No:** E88199

**Distribution:** Europe, Cameroun, Nigeria.

**Comments**

*Physarum mutabile* (Rostaf.) G. Lister is a variable species. It has sessile and stalked forms. In the stalked form, lime granules aggregate to form pseudo-columella which is absent in the sessile form. The present Nigerian collection is a sessile form with thin peridium with occasional deposit of lime. It differs from type description only in having smaller spores (6.7 µm in diameter) as against 8 µm – 10um in diameter of type description. The present report is the first record from Nigeria.

*Physarum nucleatum* Rex, *Proc. Acad. Phila.* 43: 389. 1891 (Fig. 6 and plate 8)

**Description:** Sporangia stipitate, spherical, white (RAL 9010), 0.25mm in diameter, erect or nodding, rarely plasmodiocarpous; peridium membr-anous, studded with rounded, white (RAL 9010) calcerous nodules, the lime sometimes scanty and the peridium metallic, the lower portion thicker and remaining as a collar on the stem after the upper portion has disappeared; stalk slender, yellowish white (RAL 1023), rugose, not calcareous, 1.4mm long; columnella lacking; capillitium dense, white (RAL 9010), the nodes small, white (RAL 9010), rounded aggregated in the center to form conspicuous ball of lime, but scarcely forming a pseudo-

columella, free from the stalk; spores black (RAL 9011) in mass, light brown (RAL 8001) by transmitted light, minutely spinulos, 10.7µm in diameter.

**Type Locality:** Abraka;
**Habitat:** Dead twig of an angiosperm;
**Collection No:** E88183

**Distribution:** Cosmopolitan.

**Comments**

*p. nucleatum* Rex is characterised by having aggregates of rounded lime bodied with white (RAL 9010) capillitium. The present collection resembles the type description but differs from it in having spores of larger dimension (10.7µm) whereas in type description spores are 6.5um – 7.5um in diameter. This species is a new record for Nigeria although it has been reported from Liberia by Farr (1959).

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Plate 6a. Photomicrograph of a fructification (x15) of *Physarum murinum* A. Lister at dehiscence showing sporangium (a) and stipe (b).

Plate 6b. Photomicrograph of part fructification (x350) of *Physarum murinum* A. Lister showing lime granules (a); and spores (x350) [b].

Plate 7a. Photomicrograph of the fructification (x15) of *Physarum mutabile* at dehiscence

Plate 7b. Photomicrograph of spores (x350) [a]; capillitia (x350) [b]; and lime granules (x350) [c].
Plate 8A: A photomicrograph of the fructification of *Physarum nucleatum* (x15) Rex with columella [a]; stipe [b]; and hypothalus [c].

Plate 8B: A photomicrograph of part of the fructification of *Physarum nucleatum* REX showing spores (x350) [a] and lime granules [b].

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