

## Microstructures in Medicinal Mushroom Cultures

Asya S. Buchalo,<sup>1</sup> Maryna Ya. Didukh,<sup>1</sup> Oksana B. Mykchaylova,<sup>1</sup>  
& Vita M. Lynovitska<sup>2</sup>

<sup>1</sup>M.G. Kholodny Institute of Botany, National Academy of Sciences of the Ukraine, 2 Tereshchenkivska St., Kiev 01001, Ukraine; <sup>2</sup>NTUU “KPI”, Faculty of Biotechnology and Biotechnology, 37 Peremogy Ave., Kiev, Ukraine

The correct identification of the taxonomic position of mushroom cultures due to their biotechnological application is a task of paramount importance. A dolipore septae and clamp connections are basic characteristics of Basidiomycetes cultures. A detailed study of clamp connections, anamorphs, and vegetative mycelium structures allows for more accurate morphological characterization of taxa introduced in pure culture.

Vegetative mycelium microstructures of more than 150 macromycetes species (Basidiomycota and Ascomycota) were studied using scanning electron microscopy (SEM). New data were obtained on the fine microstructures in cultures of medicinal mushroom species of the genera *Pleurotus*, *Ganoderma*, *Trametes*, *Agaricus*, *Auricularia*, *Oudemansiella*, *Coprinus*, *Marasmius*, *Morchella*, and species *Lentinus edodes* (Berk.) Singer, *Hericium erinaceus* (Bull.) Pers., *Grifola frondosa* (Dicks.:Fr.) S.F.Gray, *Hypsizygus marmoreus* (Peck) H.E. Bigelow, *Schizophyllum commune* Fr.:Fr., *Piptoporus betulinus* (Bull.:Fr.) P.Karst., *Omphalotus olearius* (DC.:Fr.) Singer, *Laetiporus sulphureus* (Bull.:Fr.) Murrill, *Polyporus squamosus* (Huds.) Fr., etc.

The presence and dislocation of clamp connections on hyphae are essential taxonomic characteristics for some species. Some species have clamps of an original form, namely *Oudemansiella mucidum* (Schrad.) Höhn., *Auricularia auricula-judae* (Fr.) Quél., and *Lentinus tigrinus* (Bull.:Fr.) Fr.; whereas *Piptoporus betulinus* (Bull.:Fr.) P. Karst., *Pleurotus*

*ostreatus* (Jacq.:Fr.) P.Kumm., and *Lyophyllum decastes* (Fr.) Singer are characterized with clamp connections of various forms and sizes. Single clamps, whorls of clamps, coupled clamps, and sprouted clamps were observed in cultures of these mushrooms. Clamps are constant in cultures belonging to species of *Pleurotus*, *Coprinus*, *Oudemansiella*, *Panus*, *Lentinus*, and *Pholiota*, but very rarely occurred in vegetative mycelium of *Agaricus* spp. (*A. subperonatus* (J.E. Lange) Singer, *A. arvensis* Schaeff., *A. bernardii* Quél., *A. comtulus* Berk. et Broome, *A. campestris* L.:Fr., *A. maskae* Pilát, *A. bernardiiformis* Bohus, *A. comtulus*, and *A. brasiliensis* S. Wässer et al.).

Different structures of asexual reproduction (anamorphs) may serve as taxonomic criterion at the species level. Arthroconidia have been found in the mycelial cultures of *Oudemansiella* spp. *Lepista nuda* (Bull.:Fr.) Cooke, *Omphalotus olearius*, *Agaricus abruptibulbus* Peck, *A. bernardiiformis*, *A. fissuratus* (F.H. Møller) F.H. Møller, *A. macrocarpus* (F.H. Møller) F.H. Møller, *A. maskae*, *A. squamuliferus* (F.H. Møller) Pilát, *A. cupreobrunneus* (Jul. Schäff. et Steer) Pilát, *A. silvaticus* Schaeff., *A. arvensis*, *Hypsizygus marmoreus*, *Lyophyllum ulmarium* (Bull.:Fr.) Kühner, *Paxillus acheruntius* (Humb.) J. Schröt., *Polyporus squamosus* (Huds.:Fr.) Fr., etc. Formation of coremia is known only for *Pleurotus abalonus* Y.H. Han, K.M. Chen et S. Cheng and *P. cystidiosus* O.K. Mill. Single globose conidia, or excretory cells, on simple conidiophores, resembling a sterigmate of the basidium, are formed

on hyphae in cultures of *Pleurotus* spp. and *Schizophyllum commune*. Chlamydospores in dicaryotic *Hericium erinaceus* cultures, dichohyphidia, and intercalar chlamydospores of *Grifola frondosa* are of taxonomic significance. An anamorphic state of oidium and *Costantinella* type is characteristic for Morchellaceae. Chlamydospores were discovered in cultures of *Agaricus bisporus* (J.E. Lange) Imbach, *A. arvensis*, *Leucocoprinus birnbaumii* (Corda) Singer, *Macrolepiota subsquarrosa* (Locq.) Bon, *Handkea excipuliformis* (Scop.) Kreisel, *Langermannia gigantea* (Batsch.) Rotsk., *Boletus edulis* Bull.:Fr., *B. queletii* Schulzer, *Suillus bovinus* (Pers.) Kuntze, *Marasmius androsaceus* (L.:Fr.) Fr., *Hypsizygus marmoreus*, *Coriolus zonatus* (Nees) Quél., *Auricularia auricula-judae*, *A. polytricha* (Mont.) Sacc., etc.

For *Coprinus cinereus* (Schaeff.) S.F.Gray, *Crinipellis shevczenkovi* Buchalo, *Agaricus gennadii* (Chatin et Boud.) P.D.Orton, and *Leucocoprinus bresadolae* (Schulzer) S.Wasser cultures sclerotia are known. Strand-like mycelial cords were found in cultures of *Agaricus arvensis*, *A. bisporus* (J.E. Lange) Imbach, *A. bitorquis* (Quél.) Sacc., *A. camp-estris*, *A. subfloccosus* (J.E. Lange) Pilát, *A. vaporarius*

Krombh., *A. brasiliensis*, *Macrolepiota procera* (Scop.) Singer, *M. excoriata* (Schaeff.) M.M. Moser, *M. mastoidea* (Fr.) Singer, *Omphalotus olearius*, *Russula ionochlora* Romagn., *Phallus impudicus* L., *Lycoperdon pyriforme* Schaeff., *Scleroderma citrinum* Pers., and *Tulostoma berteroanum* Speg.

Hyphae ornamentation observed in *Lyophyllum* spp. cultures may serve as taxonomic characters. Warty ornate-ments were detected in *Oudemansiella brunneomarginata* Lj.N. Vassiljeva and *O. mucida* on the loop forming hyphae. Lacunose structured hyphae are described in some species of Morchellaceae. Formation of calcium oxalate crystals was observed in all investigated species of *Agaricus*. Polygonal, hair-like crystals and crystals of other shapes were observed in *Hypsizygus marmoreus*, *Hericium erinaceus*, *Lentinus edodes*, *Armillariella mellea* (Vahl) P.Karst., *Pholiota jahnii* Tjall.-Beuk. et Bas, *Clitocybe odora* (Bull.:Fr.) P. Kumm., *Kuehneromyces mutabilis* (Schaeff.) Singer et A.H. Sm., *Peniophora gigantea* (Fr.) Massee, *Omphalotus olearius*, *Coprinus comatus* (O.F. Müll.) S.F.Gray, *Agaricus fissuratus*, *A. subfloccosus*, and *Montagnea arenaria* (DC.) Zeller.