

Outlineoffungi.org - Note 904 *Incertae sedis* genera of major phyla

Incertae sedis status in higher level fungal classification – an elephant in the room

The classification of fungi has undergone numerous revisions and amendments over time. Fungal classification has historically focused on the grouping of critical morphology-based distinguishing traits. Through multiple articles and modifications in the last two ICNafp, the rules governing the name of fungus and the international codes were revisited substantially. The one fungus: one name concept and priority criteria were established for pleomorphic species, and names were subject to conservation (*nomina conservanda*) and rejection (*nomina rejicienda*). Significant changes have been made in the naming and classification of fungi with the advent of molecular sequencing technology and its uses in the taxonomy of fungi. The formerly morphology-reliant fungal classification has new criteria owing to the multigene sequencing data (primary and secondary barcodes) and phylogeny based on sophisticated statistical algorithms like the coalescence method and divergence time estimations. However, the code has never addressed the uncertain status of valid species, instead, the authors or mycological index (*Index Fungorum*) categorized them as *incertae sedis*.

Fungi are primarily placed under uncertain positions or in the technical term, *incertae sedis* are the dustbin groups of the classification that need careful treatment. In the modern taxonomic era, addressing the precise causes of species placed in ambiguity is crucial. A better approach is inevitable while studying the taxonomy of several important fungi listed in *incertae sedis*. In terms of morphology-based identification, *incertae sedis* taxa are well-defined with key distinguishing characteristics and illustrations. Although these *incertae sedis* taxa were accurately placed inside a genus circumscription, the authors have not positioned them in a family, order, class, or phyla. It may be due to the author's lack of expertise in higher classifications or because the fungus differs significantly from other recognized taxa in critical morphological characteristics. Likewise, the lack of asexual-to-sexual linkages in certain fungi and the reliance only on morphology in traditional taxonomic approaches are the other causes of this ambiguity in the placement of taxa in the higher-level classification.

In the current era, it is challenging to validate such taxa through additional molecular research, nomenclature treatments, and revisions due to deteriorated or inadequate type materials (holotype, isotype) and the availability of representative axenic ex-types. Traditional taxonomic approaches primarily relied on accessing fungaria specimens loaned through policies and trust to verify authentic types like holotypes and isotypes for taxonomic revisionary studies. The availability of type material from around the world was restricted by stringent local biodiversity policies, strict import/export/quarantine laws of various nations, and improbable international cooperation in loaning the type material from recognized fungaria. Unethical practices and breach of integrity or mishandling of important types have also limited the possibility of material exchange for revalidation. The classification of taxa belonging to *incertae sedis* can be effectively resolved by recollecting such fungi from their original collection sites through worldwide collaboration among fungal taxonomists. In the modern fungal taxonomic era, molecular methods will be useful to resolve the accurate phylogenetic position of these fungi in the classification. To achieve a far more accurate prediction of the fungal tree of life, correct placement of the *incertae sedis* taxa is unavoidable and equally relevant to DNA-based species concepts evolving in the current taxonomic era.

The uncertainty in the classification of fungal species was present at various ranks, including phylum, subphylum, class, subclass, order, and families. An overall assessment of uncertain positions of fungi based on the recent Outline of fungi and fungus-like taxa (2021) shows a huge disparity in the phylogenetic placement of well-established legitimate genera. Surprisingly, the kingdom of fungi and fungus-like taxa contains 3173 genera of fungi that were designated *incertae sedis*. Ascomycota, one of the many phyla of fungus, includes the most significant number of *incertae sedis* taxa, about 2668 genera. Including these legitimate genera will drastically alter the interspecies relationships and evolutionary patterns within several families and orders.

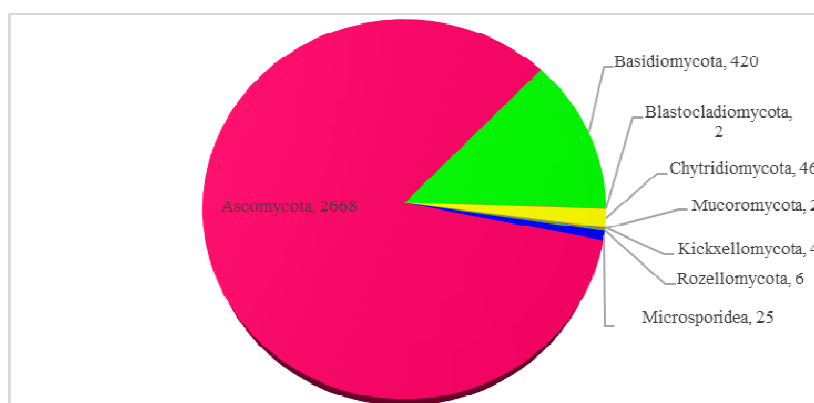


Fig 1 – Number of *incertae sedis* taxa belonging to different Phyla.

Comparably, *Basidiomycota* accounts for 420 *incertae sedis* genera followed by Chytridiomycota (46 genera) and Microsporidia (25 Genera). In the *Ascomycota*, approximately 1481 genera were never placed under any higher classification ranks. The *incertae sedis* genera of *Dothideomycetes* account for 459 genera, followed by *Sordariomycetes* 395 genera. Similarly, *Leotiomycetes* consists of 54 genera, *Eurotiomycetes* 29 genera, *Saccharomycetes*, 22 genera, and *Pezizomycetes* 18 genera. Among the fungal families of Ascomycota, a total of 76 families were reported as *incertae sedis*, which included 41 families of *Dothideomycetes* consisting of 93 genera followed by 22 families of *Sordariomycetes* composed of 51 genera. Likewise, seven families were not classified under any higher ranks of Ascomycota.

Ascomycota			
Class	Genus	Family	Order
<i>Arthoniomycetes</i>	21	-	-
<i>Dothideomycetes</i>	459	41	-
<i>Eurotiomycetes</i>	29	1	-
<i>Geoglossomycetes</i>	2	-	-
<i>Laboulbeniomycetes</i>	4	-	-
<i>Lecanoromycetes</i>	54	4	1
<i>Leotiomycetes</i>	179	1	-
<i>Orbiliomycetes</i>	4	-	-
<i>Pezizomycetes</i>	18	-	-
<i>Sordariomycetes</i>	395	22	7
<i>Saccharomycetes</i>	22	-	-
<i>Ascomycota unclassified</i>	1481	7	-

Fig.xx *Incertae sedis* genera

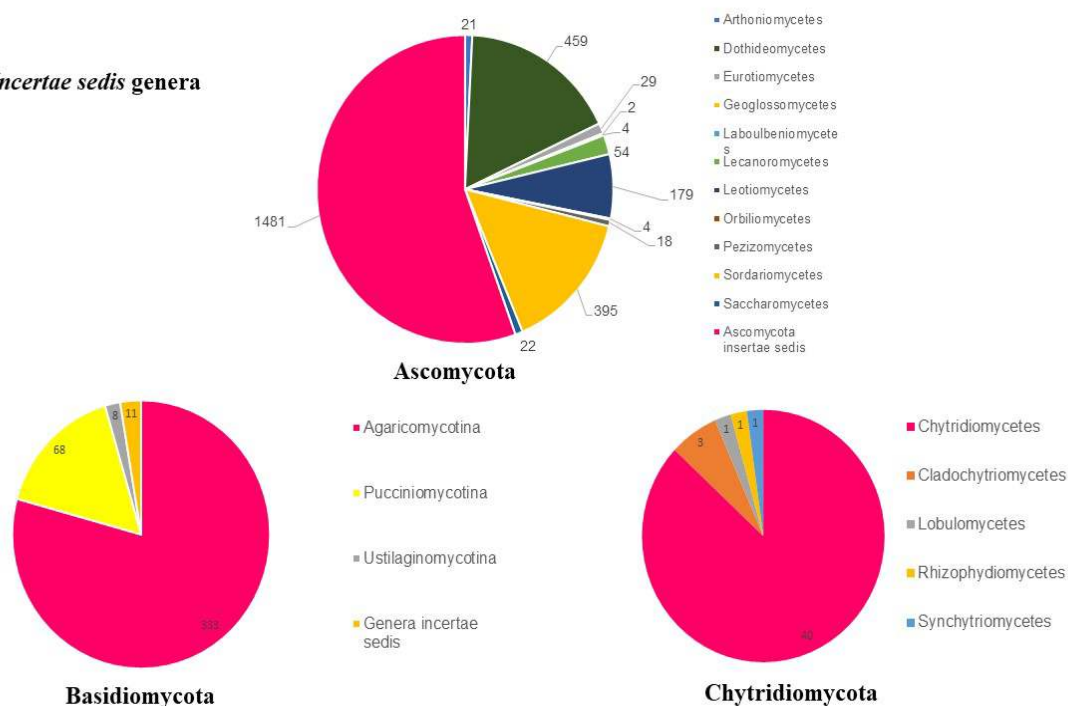


Fig 2- *Incertae sedis* genera of major phyla

In phylum *Basidiomycota*, 420 *incertae sedis* genera have been discovered so far. The *incertae sedis* genera are placed under the three subphyla: *Agaricomycotina*, *Pucciniomycotina*, and *Ustilaginomycotina*. *Agaricomycotina* encompasses 333 genera, followed by *Pucciniomycotina* and *Ustilaginomycotina*, with 68 and 8 genera, respectively. Apart from this, 11 genera *incertae sedis* recorded under the phylum *Basidiomycota*, that are not placed under any subphyla. The highest number of *incertae sedis* genera in *Agaricomycotina* may be because of the more floristic studies carried out worldwide before and after the use of molecular sequencing tools in taxonomy. In *Chytridiomycota* 46 genera are uncertain of position. *Cytridiomycetes* accounts for the 40 *incertae sedis* genera, followed by *Cladochytriomycetes* with three genera. The rest of the classes *Lobulomycetes*, *Rhizophydiomycetes*, and *Synchytriomycetes* each contain 1 *incertae sedis* genera.

Reference

Wijayawardene NN, Hyde KD, Dai DQ, Sánchez-García M, Goto BT, Magurno F. 2022 – Outline of Fungi and fungus-like taxa–2021. *Mycosphere* 13(1), 53–453. <https://doi.org/10.5943/mycosphere/13/1/2>

Entry by

Rajesh Kumar, National Fungal Culture Collection of India (NFCCI)

(Edited by Kevin D. Hyde & Maryam Tavakol Noorabadi)

Published online 5 April 2024