



Группа *Penicillium* - *Aspergillus* — от морфологии к филогении



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Москва 2017

Aspergillus - Penicillium — «плесень» с которой мы сталкиваемся чаще всего

- Биоповреждения
- Контаминация продуктов
- Образование токсинов
- Условно патогенные и аллергенные виды
- Медицинские и биотехнологические препараты (антибиотики, ферменты)
- Переработка отходов



Ascomycota, Pezizomycotina, Eurotiomycetes, Eurotiomycetidae, Eurotiales, Trichocomaceae

Aspergillus

Penicillium

- Mycobank — 1072 записей
- Index Fungorum — 983 записей
- Species Fungorum — 741

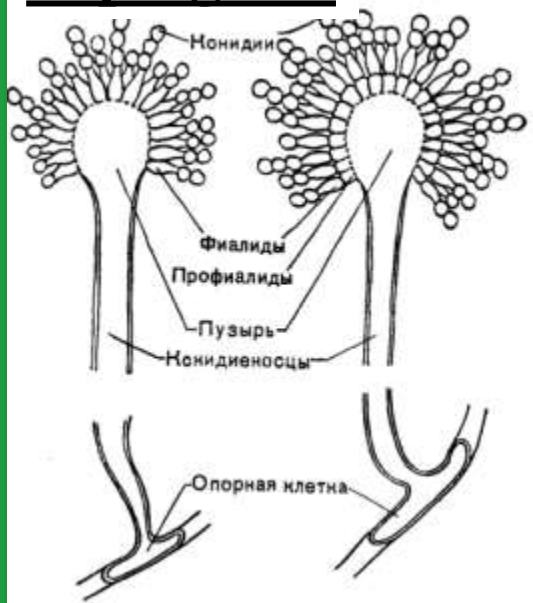
- Mycobank — 1390
- Index Fungorum — 1259
- Species Fungorum — 880

известных видов и разновидностей

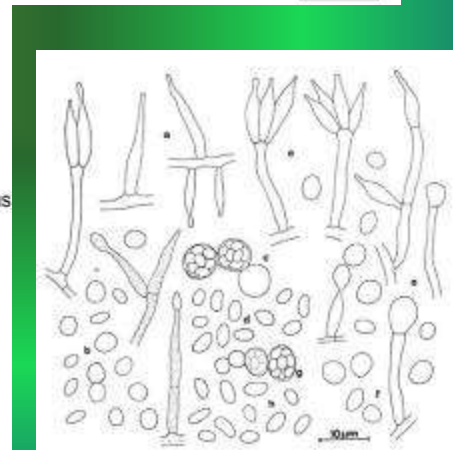
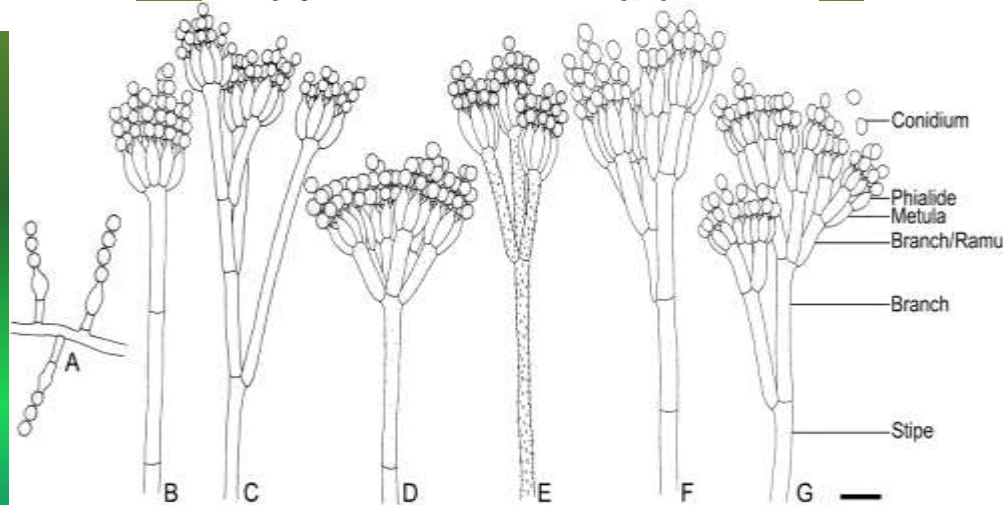
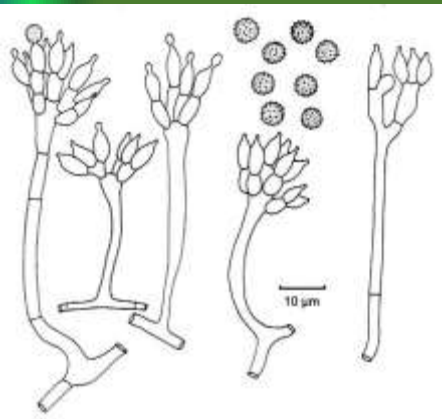
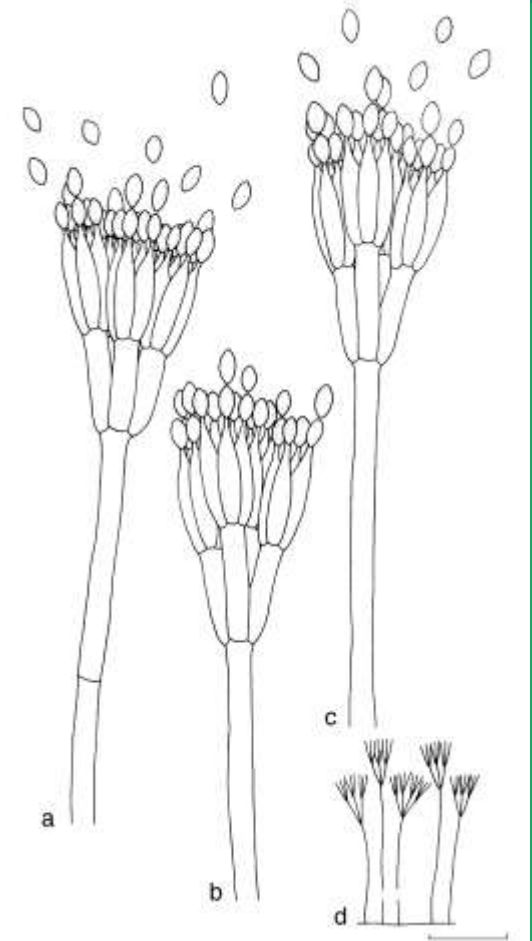
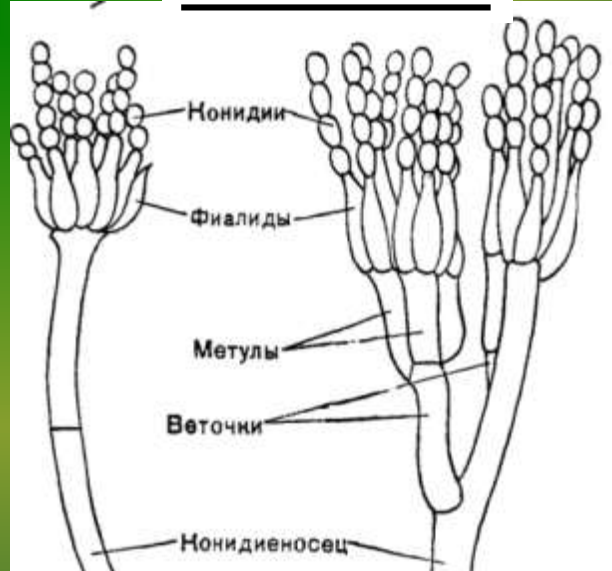


Морфология

Aspergillus



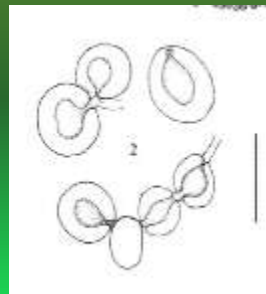
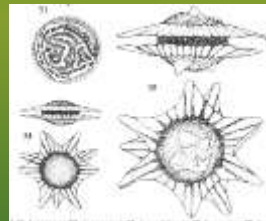
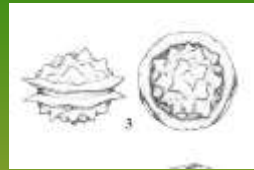
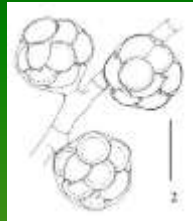
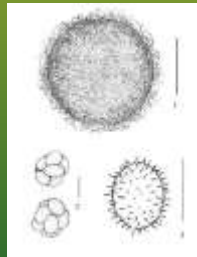
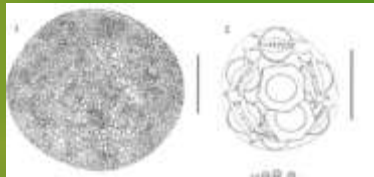
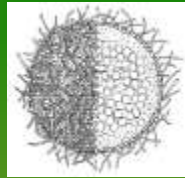
Penicillium



Телеоморфы

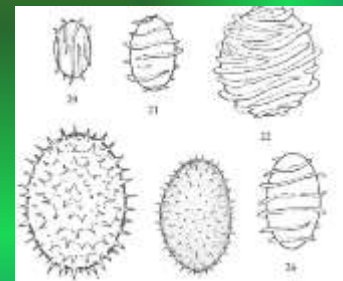
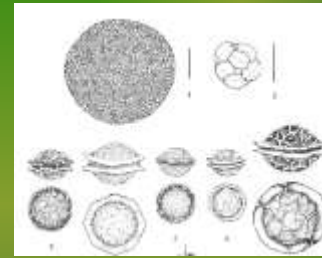
Aspergillus

- *Chaetosartorya*
- *Dichotomomyces*
- *Emericella*
- *Eurotium*
- *Fennellia*
- *Hemicarpenteles*
- *Neocarpenteles*
- *Neopetromyces*
- *Neosartorya*
- *Petromyces*
- *Sclerocleista*
- *Warcupiella*



Penicillium

- *Eupenicillium*
- *Talaromyces*



Классификация внутри рода *Penicillium*

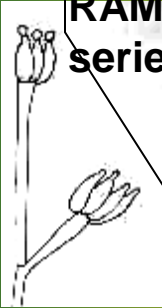
Section
MONOVERTICILLATA



Section ASYMETRICA

Subsection
DIVARICATA

RAMIGENA
series



P. CITRINUM
series



Subsection VELUTINA

Subsection LANATA

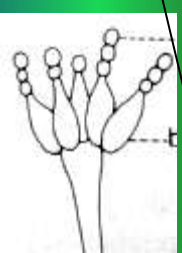
Subsection FUNICULOSA

Subsection FASCICULATA

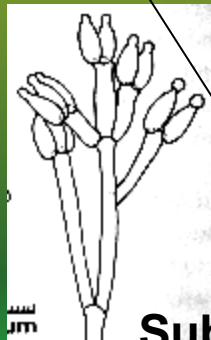
Section
BIVERTICILLATA
SYMMETRICA



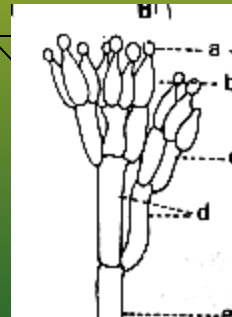
Raper, Thom, 1949



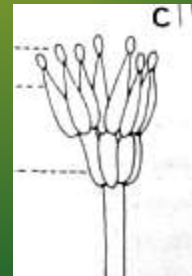
Subgenus
ASPERGILLOIDES



Subgenus
FURCATUM



Subgenus
PENICILLIUM




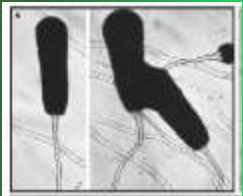




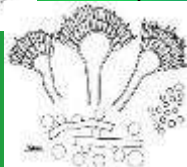


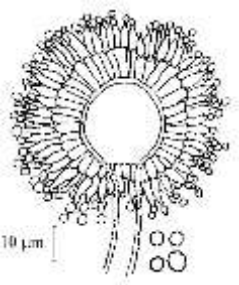
Subgenus
BIVERTICILLIUM

Pith 1979

Eupenicillium

Talaromyces

Классификация внутри рода *Aspergillus*

Raper, Fennell, 1965 Группы (18)	Samson, Pitt, 1985 Подроды (7) и секции (19)	Телеоморфа	
<i>A. glaucus</i> <i>A. restrictus</i>	Подрод <i>Aspergillus</i> Секция <i>Aspergillus</i>	<i>Eurotium</i>	
<i>A. fumigatus</i> <i>A. cervinus</i>	Секция <i>Restricti</i> Подрод <i>Fumigati</i> Секция <i>Fumigati</i>	<i>Neosartorya</i>	
<i>A. ornatus</i>	Секция <i>Cervini</i> Подрод <i>Ornati</i>	<i>Sclerocleista</i> <i>Hemicarpensteles</i> <i>Warcupiella</i>	
<i>A. clavatus</i>	Секция <i>Ornati</i> Подрод <i>Clavati</i>	<i>Neocarpensteles</i> <i>Dichotomomyces</i>	
<i>A. nidulans</i> <i>A. versicolor</i>	Секция <i>Clavati</i> Подрод <i>Nidulantes</i>	<i>Emericella</i>	
<i>A. ustus</i> <i>A. terreus</i> <i>A. flavipes</i>	Секция <i>Nidulantes</i> Секция <i>Versicolores</i> Секция <i>Usti</i>	<i>Fennellia</i>	
<i>A. wentii</i> <i>A. flavus</i>	Секция <i>Terrei</i> Секция <i>Flavipedes</i> Подрод <i>Circumdati</i>	<i>Chaetosartorya</i>	
<i>A. niger</i> <i>A. ochraceus</i> <i>A. candidus</i>	Секция <i>Wentii</i> Секция <i>Flavi</i> Секция <i>Nigri</i>	<i>Petromyces</i>	
<i>A. cremeus</i> <i>A. sparsus</i>	Секция <i>Circumdati</i> Секция <i>Candidi</i>	<i>Petromyces</i>	
<i>A. flavus</i>	Секция <i>Cremeri</i> Секция <i>Sparsi</i> Подрод <i>Stilbothamnium</i>	<i>Neopetromyces</i>	
	Секция <i>Stilbothamnium</i>		

Интеграция анаморфных видов в естественную систему грибов

International Mycological Congress (IMC9) Edinburgh, Scotland August 3-5, 2010

IMC9 Edinburgh Nomenclature Sessions

Session 3: Moving to one name for one fungus and ending the requirement of Latin diagnoses for valid publication

2011 IBC Nomenclature Section at Melbourne

Принцип - «one fungus : one name» был официально установлен

**International Code of Nomenclature
for
algae, fungi, and plants
(Melbourne Code)**

adopted by the Eighteenth International Botanical Congress Melbourne,
Australia, July 2011

CBS Symposium: One Fungus = One Name

On 19–20 April 2011, the CBS-KNAW Fungal Biodiversity Centre, under the auspices of the International Commission on the Taxonomy of Fungi (ICTF), organised a symposium on 'One Fungus = One Name' at the Tippenhuis (home of the Royal Netherlands Academy of Arts and Sciences) in Amsterdam. Ninety participants from 23 countries attended the symposium.

The programme consisted of 18 presentations, which discussed various important taxonomical issues. Questions which were debated, included:

Important contributions were presented by John Taylor, Mike Wingfield, David Hawksworth, Willem Gerrits, Keith Seifert, Scot Redhead, Uno Ruus, Andru Levesque, Ulf Thams, Sjoerd de Hoog, Wuband Meyer, Jans Varga, Joël Heuvelink, PengXin Bai, and Joost Stalpers, which provided a lively discussion. On the second day, David Hawksworth prepared a document, based on a draft written by Keith Seifert, and entitled the Amsterdam Declaration on Fungal Nomenclature. The working paper was discussed in detail and accepted by almost all of the audience. After the symposium, the



International Commission of Penicillium and Aspergillus

(A Commission of the International Union of Microbiological Societies (IUMS) <https://www.aspergilluspenicillium.org>)

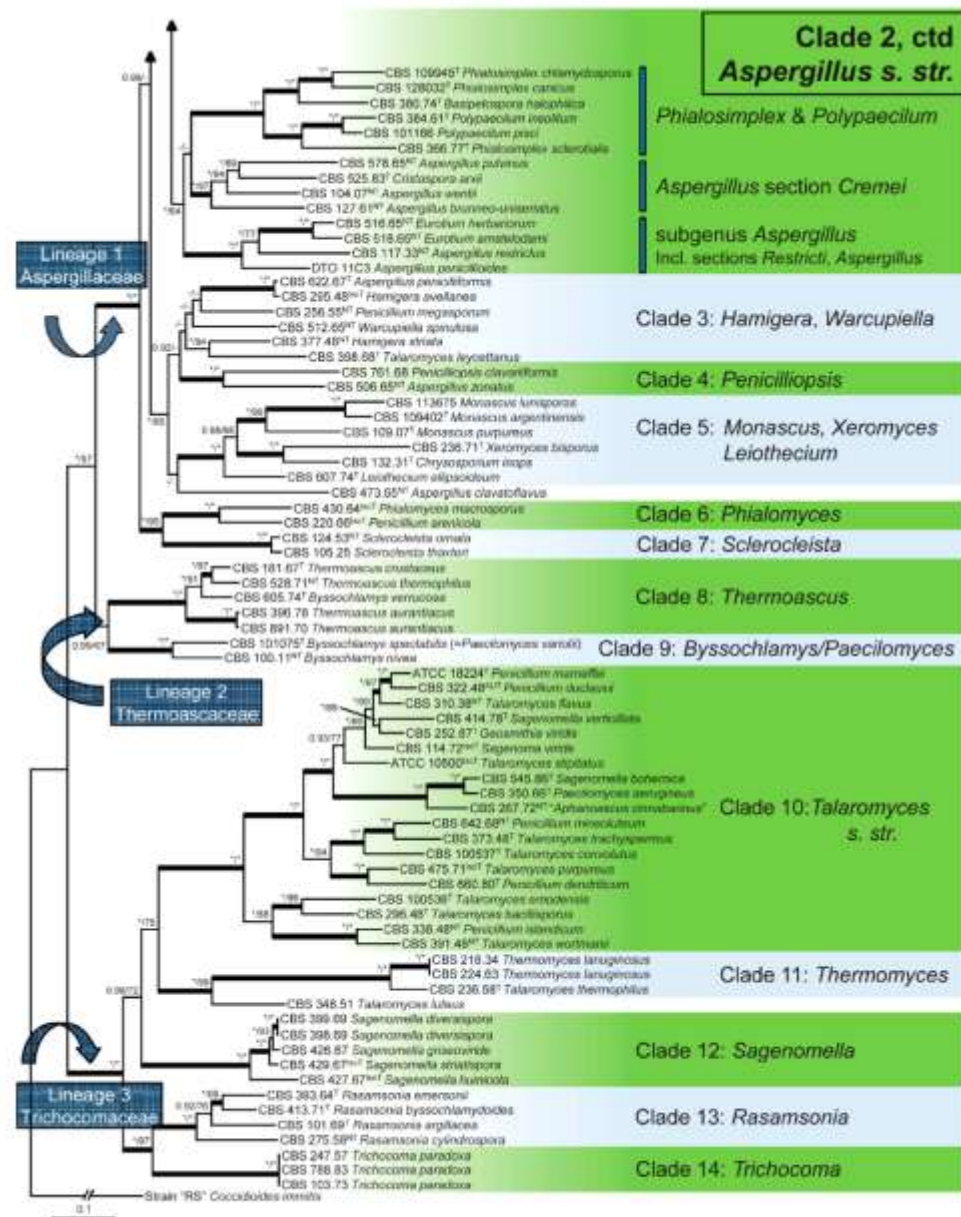
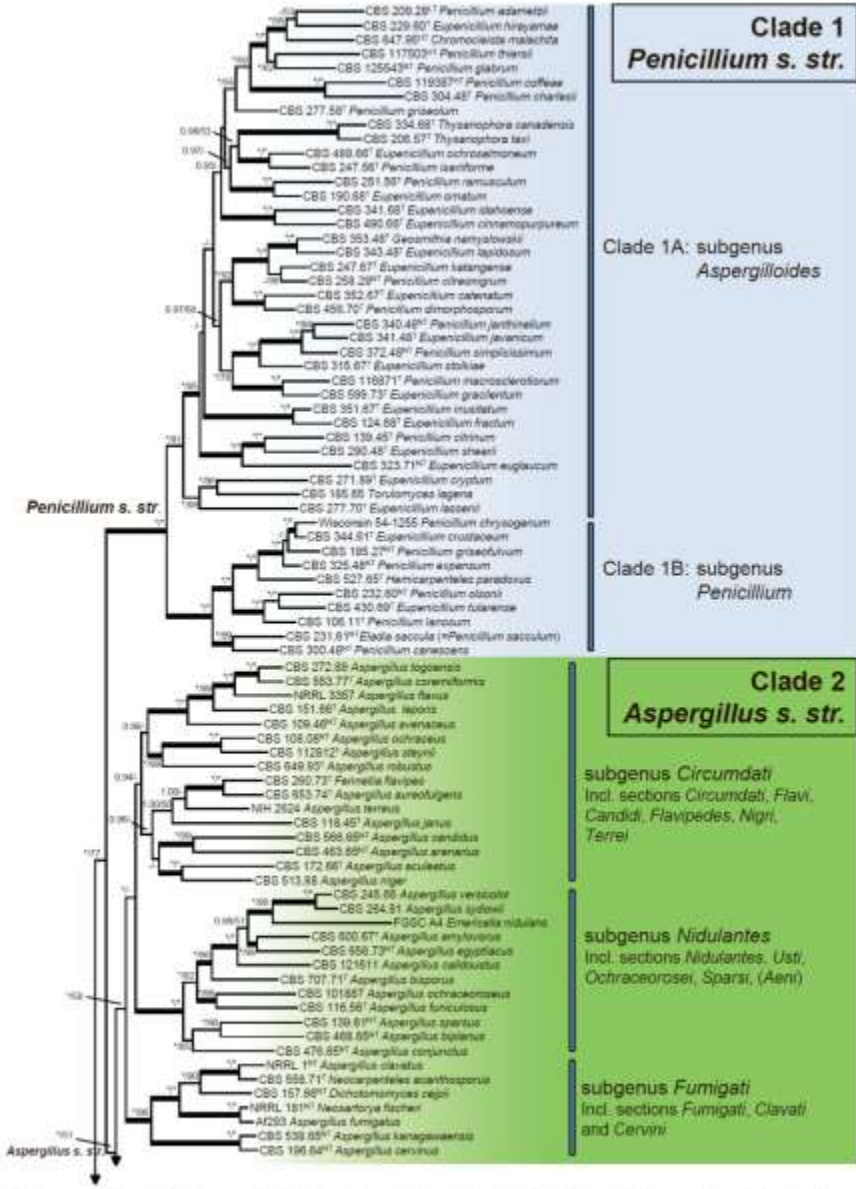


Fig. 1. Best-scoring Maximum Likelihood tree using RAxML based on combined data set of partial *Cds*, *Tcr1*, *RPB1* and *RPB2* sequences showing the relationship among members of Trichocomaceae. The BI posterior probabilities (pp) values and bootstrap (bs) percentages of the maximum likelihood (ML) analysis are presented at the nodes (pp/bs). Values less than 50 % supported in the ML or less than 0.90 in the Bayesian analysis are indicated with a hyphen, whereas asterisks indicate full support (100 % bs or 1.00 pp). The branches with more than 95 % bootstrap support and 1.00 posterior probability values are thickened. The bar indicates the number of substitutions per site. The tree is rooted with *Coccidioides immitis* (strain RS).

Fig. 1. (Continued)

Houbraken, J., & Samson, R. A. (2011). Phylogeny of *Penicillium* and the segregation of *Trichocomaceae* into three families. *Studies in Mycology*, 70, 1-51.

Разделение семейства Trichocomaceae на три

Ascomycota, Pezizomycotina, Eurotiomycetes, Eurotiomycetidae, Eurotiales

Aspergillaceae Link, Abh. dt. Akad. Wiss. Berlin 1824: 165. 1826.

- = *Eurotiaceae* Clements and Shear, Gen. Fung. 50. 1931.
- = *Monascaceae* J. Schröter, Nat. Pflanzenfamilien 1: 148. 1894.
- = *Hemicarpenteleaceae* Locquin, Tribune Méd. (Paris) 1. 1972. *nom. inval.* (Art. 36).
- = *Penicilliaceae* Vuillemin, Pl. Jungh. 10: 172. 1910. (as *Penicilliaceae nom. inval.* Art. 32.1b).
- = *Penicilliosepsidaceae* Locquin, Tribune Méd. (Paris) 1. 1972. *nom. inval.* (Art. 36).
- = *Phialomycetaceae* Locquin, Mycologie générale et structurale: 212. 1984. *nom. inval.* (Art. 36).
- = *Warcupiellaceae* Locquin, Mycologie générale et structurale: 167. 1984. *nom. inval.* (Art. 36).
- = *Xeromycetaceae* Locquin, Tribune Méd. (Paris) 1. 1972. *nom. inval.* (Art. 36).

Type: *Aspergillus* Fr. Fr.

Aspergillus (incl. teleomorphs, syn. *Stilbothamnium*)

Hamigera (incl. *Merimbla*)

Leiothecium

Monascus (incl. *Basipetospora*)

Penicilliosepsis

Penicillium (syn. *Chromocleista*, *Eladia*, *Eupenicillium*, *Hemicarpenteles*, *Thysanophora*, *Torulomyces*)

Phialomyces

Phialosimplex

Polypaecilum

Sclerocleista

Warcupiella (incl. *Raperia*)

Xeromyces

Trichocomaceae E. Fischer, Nat. Pflanzenfam. 1: 310. 1897. (as *Trichocomataceae*)

- = *Talaromycetaceae* Locquin, Mycologie générale et structurale: 176. 1984. *nom. inval.* (Art. 36).
- = *Dendrosphaeraceae* Ciferri ex Benny & Kimbrough, Mycotaxon 12: 22. 1980.

Type: *Trichocoma* Junghuhn

Paecilomyces (incl. *Byssochlamys*)

Thermoascus (syn. *Coonemeria*, *Dactylomyces*)

Thermoascaceae Apinis, Trans. Br. Mycol. Soc 50: 581. 1967.

Type: *Thermoascus* Miehe

Dendrosphaera (tentatively, *fide* Malloch 1985b)

Rasamsonia

Sagenomella

Talaromyces (syn. *Sagenoma*, *Erythrogymnotheca*)

Thermomyces

Trichocoma

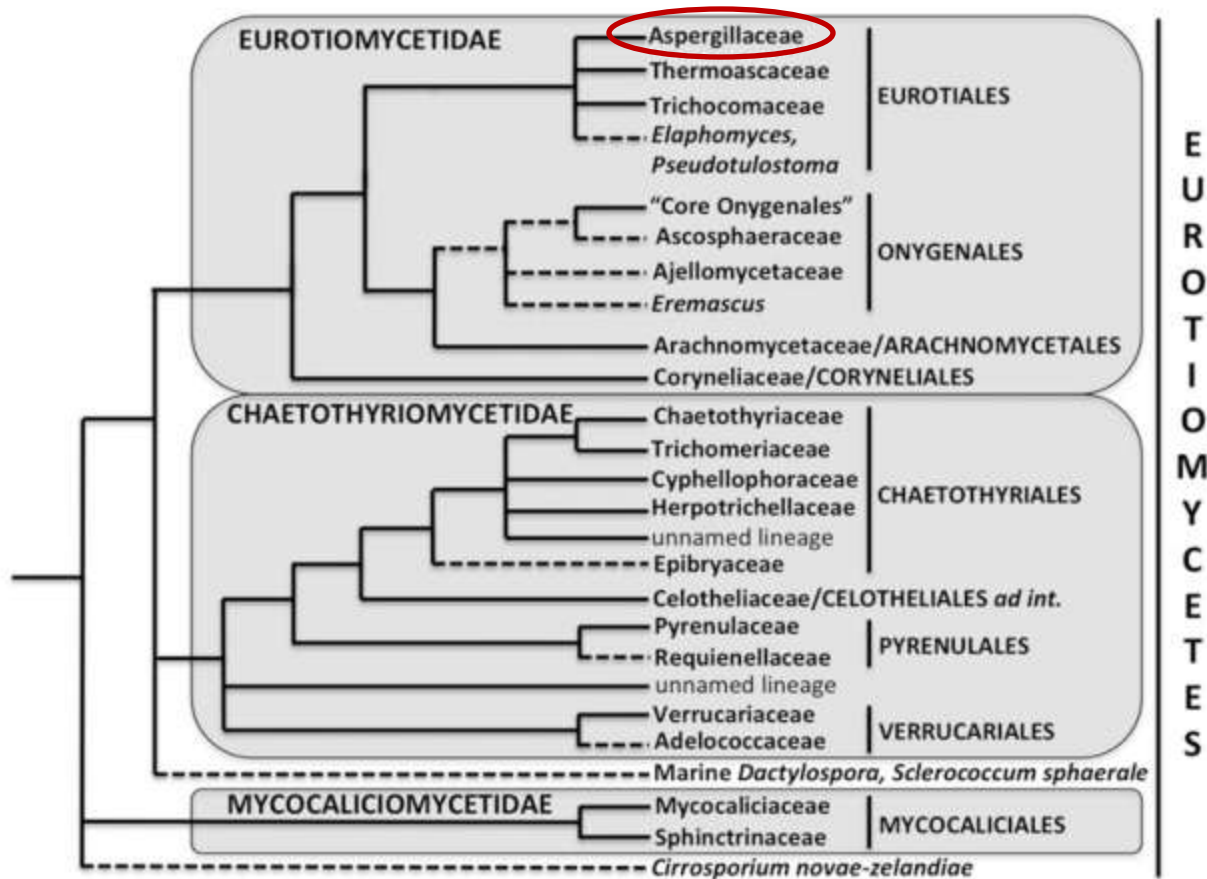


Fig. 5.26 Phylogenetic tree representing current state of knowledge regarding phylogenetic relationships within Eurotiomycetes. Taxa of uncertain or poorly supported phylogenetic position are represented as dashed lines. "Core Onygenales" refers to Onygenaceae, Gymnoascaceae, Arthrodermataceae, and Nannizziopsiaceae (Sect. I.A.2.a). "Unnamed lineages" refer to unnamed lineages 1 and 2 in Gueidan et al. (2014). Phylogenetic positions are inferred based on the stud-

ies of Berbee and Taylor (1992), Bowman et al. (1996), del Prado et al. (2006), Diederich et al. (2013), Gargas et al. (1995), Geiser and LoBuglio (2001), Geiser et al. (2006), Gibas et al. (2002), Gueidan et al. (2014), Henkel et al. (2001), Houbraken and Samson (2011), Hyde et al. (2013), Klinger et al. (2013), R  blow and Seifert (2012), Stchigel et al. (2013), Tibell and Wedin (2000), and Untereiner et al. (2002)

John I. Pitt & John W. Taylor
(2014)

Aspergillus, its sexual states and the new International Code of Nomenclature

Mycologia, 106:5, 1051-1062,
DOI: 10.3852/14-060

Penicillium попадает
внутри Aspergillus
Клады соответствуют
телеоморфным родам
Возможна широкая или
узкая трактовка рода

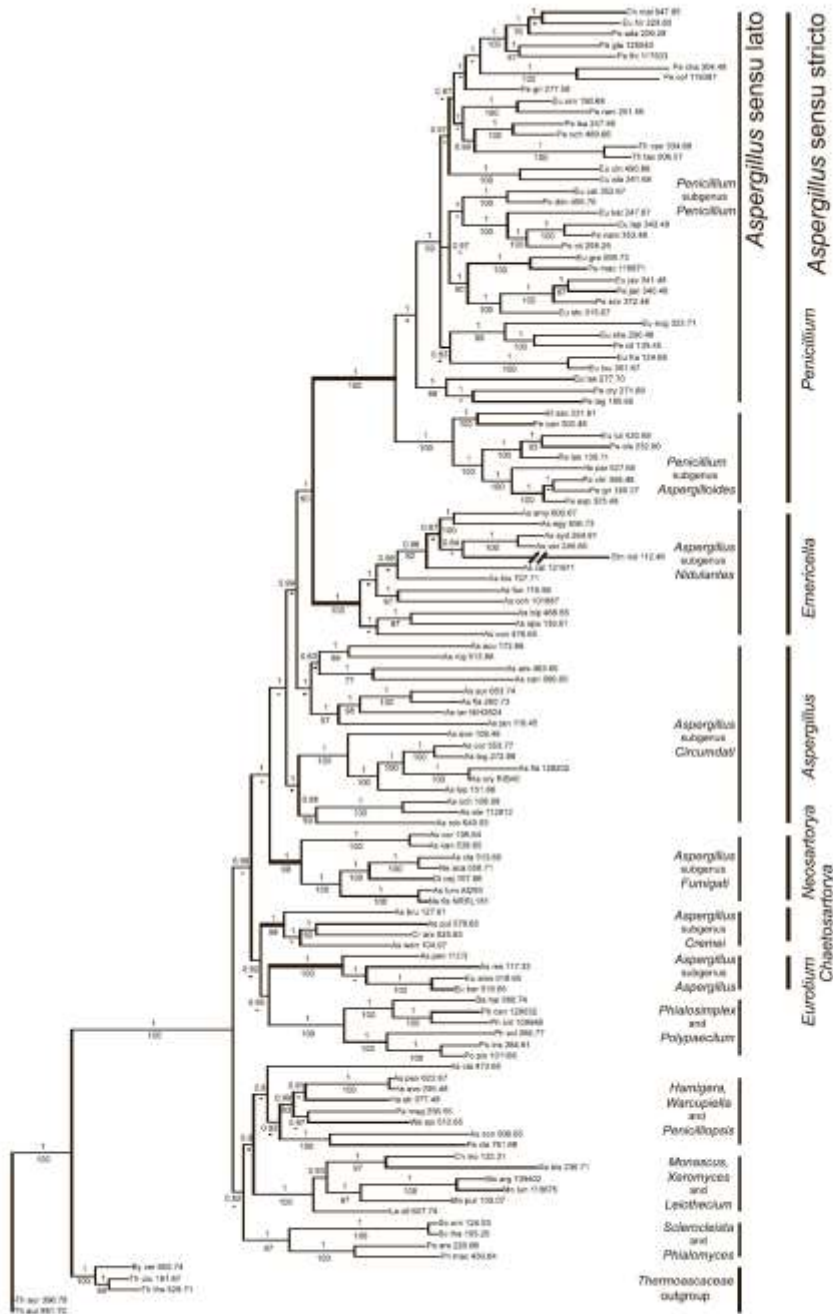


FIG. 1. Bayesian and maximum likelihood phylogenetic analyses of *Aspergillus* and related taxa made with four genes: the RPB1 and RPB2 subunits of RNA polymerase II, *Tsr1*, a putative ribosome biogenesis protein and *Cet8*, the putative chaperonin complex component, TCP-1. Numbers above internal branches are Bayesian probabilities; numbers below are maximum likelihood bootstrap percentages. Taxon names correlate with those in TABLE II. An asterisk marks the end of the

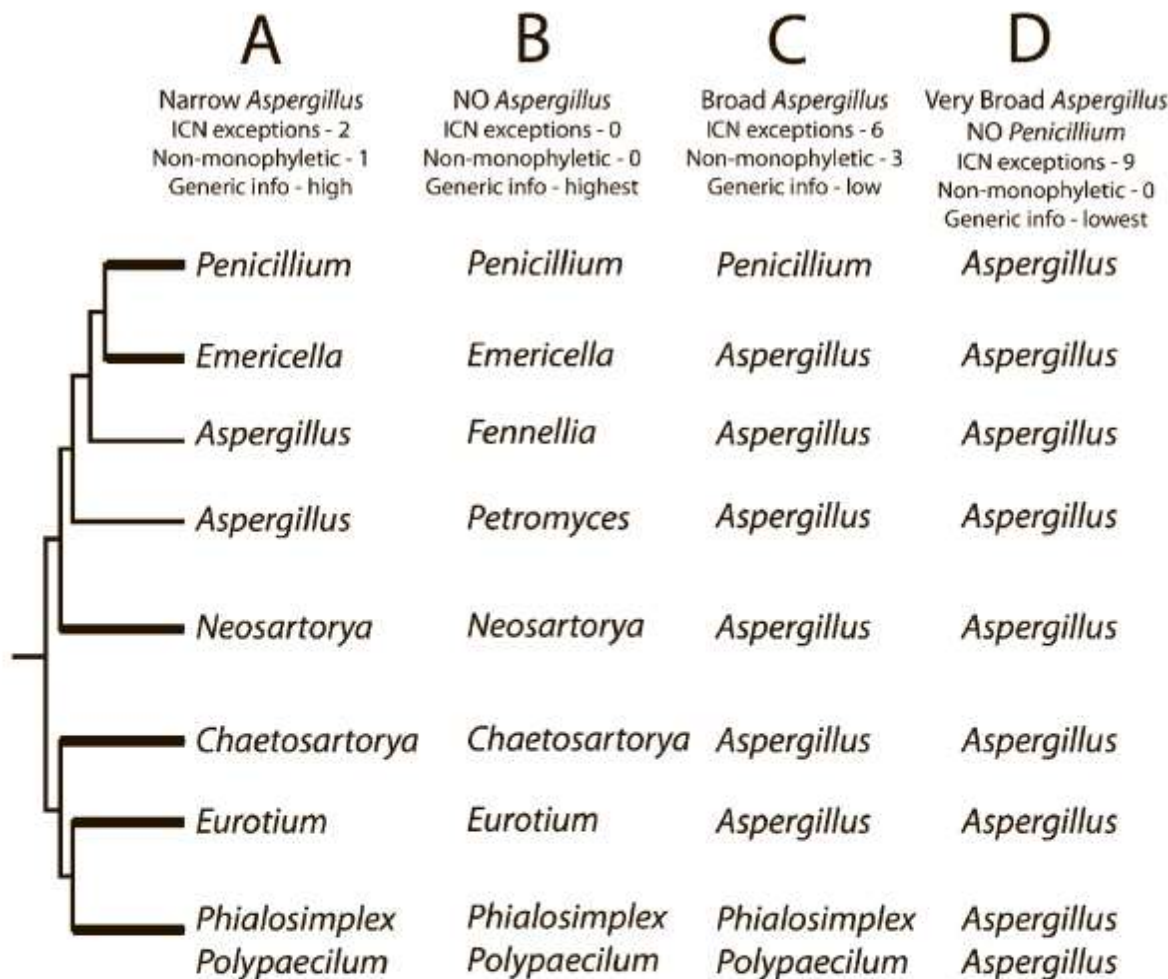


FIG. 2. Effect of the choice of teleomorph or anamorph names on appeals for exceptions to the ICN priority rule, non-monophyly of genera and information content of the generic names. Phylogenetic cartoon with strongly-supported branches thickened, based on the phylogeny presented in FIG 1. A. A narrowly defined genus *Aspergillus*. The ICN must be asked for approval to apply the name *Aspergillus* to the non-monophyletic grade embracing *Petromyces* and *Fennellia*. The information content of the genera would be high because each name embraces one monophyletic clade or, in the case of *Aspergillus*, a small grade. B. Abandon the genus *Aspergillus* by applying the teleomorph name to every clade. This approach is fully compliant with the ICN, and all names would be applied to monophyletic clades. The information content would be high. However, the name *Aspergillus* would be lost to mycology. C. Apply the name *Aspergillus* broadly to all clades having *Aspergillus* anamorphs. Six exceptions to the ICN would be needed. *Aspergillus* would be made non-monophyletic by the inclusion of *Penicillium*, *Phialosimplex* and *Polypaecilum*. The information content of the name *Aspergillus* would be low due to the large phenotypic variation found among the six clades bearing the name *Aspergillus*. D. Make *Aspergillus* broad by applying the name to species in the genera *Penicillium*, *Phialosimplex* and *Polypaecilum*. Nine exceptions to the ICN would be needed, but *Aspergillus* would be monophyletic. The information content of the name *Aspergillus* would be low, due to the extreme phenotypic variation in the broad genus. The name *Penicillium* would be lost to mycology.

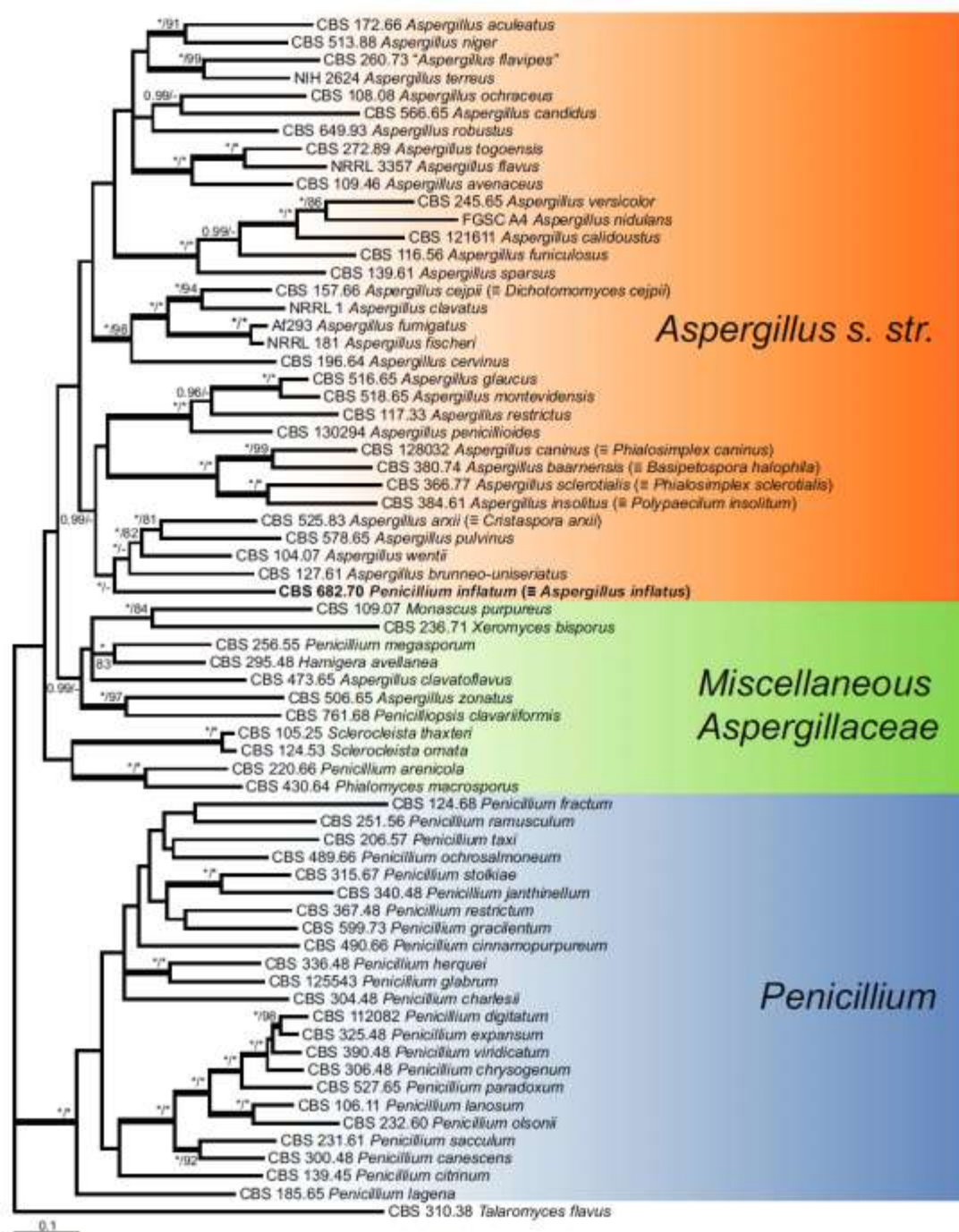
Авторы предлагают
принять узкую
трактовку родов,

Penicillium
сохраняется

Aspergillus
распадается на ряд
родов в
соответствии с
телеоморфами

Samson RA, Visagie CM, Houbraken J, Hong SB, Hubka V, Klaassen CHW, Perrone G, Seifert KA, Susca A, Tanney JB, Varga J, Kocsubé S, Szigeti G, Yaguchi T, Frisvad JC (2014) Phylogeny, identification and nomenclature of the genus *Aspergillus*. *Studies in Mycology* 78: 141-173.

Принята широкая трактовка рода *Aspergillus*
Описание рода дополнено



Aspergillus P. Micheli ex Haller, emended description

Generic type: *Aspergillus glaucus* (L.) Link

Vegetative mycelium hyaline to brightly pigmented. Conidiophores (aspergillum) consisting of thick-walled basal cells (foot cell) producing stalks, usually aseptate and unbranched, terminating in inflated apex (vesicle) which can be globose, ellipsoidal to clavate; conidiophores in some species may be septate, lack a foot cell, lack a vesicle, or consisting of single conidiogenous cells with one to several loci. Conidiogenous cells phialidic, producing dry conidial chains borne directly on the vesicle (uniseriate) or on metulae (biseriate); in a few species, appearing to be annellidic or polyphialidic. Conidia greatly varying in colour, size, shape and ornamentation. Cleistothecia of various structures produced by some species with mostly a thin ascocoma wall consisting of a single layer of hyphal networks, sometimes covered by layers of Hülle cells or sclerotium-like. Asci globose usually containing eight ascospores. Ascospores often lenticular, hyaline or coloured, varying in size, shape and ornamentation. Sclerotia or sclerotium-like structures regularly present in some species, varying in colour, size and shape, consisting of thick-walled cells, sometimes containing ascigerous structures. Hülle cells sometimes covering cleistothecia or occurring in compact masses in the mycelium, varying in shape and size, but mostly thick-walled and hyaline.

Fig. 4. Combined phylogeny of the RPB2, CctB and Tsr1 gene regions showing the phylogenetic position of *P. inflatum* (= *A. inflatus*) in *Aspergillus* sect. *Cremii*. The tree was rooted to *Talaromyces flavus*. Branches with bootstrap support above 80 % and/or posterior probability above 0.95 are given above thickened branches.

Visagie CM, Houbraeken J, Frisvad JC, Hong SB, Klaassen CHW, Perrone G, Seifert KA, Varga J, Yaguchi T, Samson RA (2014) Identification and nomenclature of the genus *Penicillium*. *Studies in Mycology* 78: 343-371.

Penicillium Link, Mag. Ges. Naturf. Freunde Berlin 3: 16. 1809. MycoBank MB9257.

= *Coremium* Link, Mag. Ges. Naturf. Freunde Berlin 3: 19. 1809, *vide* Raper & Thom 1949, Seifert & Samson 1985. [MB7782]. anamorphic synonym.

= *Floccaria* Grev., Scott. crypt. fl.: pl. 301. 1827, *vide* Seifert & Samson 1985. [MB8260]. anamorphic synonym.

?= *Hormodendrum* Bonord., Handbuch allg. Mykol.: 76. 1851 *vide* de Hoog & Hermanides-Nijhof 1977, but see Hughes 1958. [MB8558]. anamorphic synonym.

?= *Walzia* Sorokin, Trudy Obshch. Ispyt. Priir. Imp. Kharkov: 47. 1871, *vide* Constantin 1888. [MB10429]. anamorphic synonym.

= *Pritzelella* Henn., Hedwigia Beibl. 42: 88. 1903, *vide* Clements & Shear 1931. [MB9529]. anamorphic synonym.

= *Eupenicillium* F. Ludw., Lehrbuch der Niederen Kryptogamen: 263. 1892, *vide* Houbraeken & Samson 2011. [MB1933]. teleomorphic synonym.

= *Citromyces* Wehmer, Ber. Deutsch. Bot. Ges. 11: 333. 1893, *vide* Thom 1930. [MB7672]. anamorphic synonym.

= *Aspergillopsis* Sopp, Skr. Vidensk.-Selsk. Christiana Math.-Nat. Kl. 11: 204. 1912, non *Aspergillopsis* Speg. 1910, *vide* Pitt 1979. [MB22043]. anamorphic synonym.

= *Carpenteles* Langeron, Crypt. Fr. Exs.: 344. 1922, *vide* Stolk & Scott 1967. [MB826]. teleomorphic synonym (= *Eupenicillium*).

= *Torulomyces* Delitsch, Systematik der Schimmelpilze: 91. 1943, *vide* Stolk & Samson 1983 and Houbraeken & Samson 2011. [MB10252]. anamorphic synonym.

= *Eladia* Smith, Trans. Brit. Mycol. Soc. 44: 47. 1961, *vide* Samson 1981, Houbraeken & Samson 2011. [MB8134]. anamorphic synonym.

= *Thysanophora* Kendrick, Can. J. Bot. 39: 820. 1961, *vide* Houbraeken & Samson 2011. [MB10230]. anamorphic synonym.

= *Hemicarpenteles* Sarbhoy & Elphick, Trans. Brit. Mycol. Soc. 51: 156. 1968, *vide* Houbraeken & Samson 2011. [MB2279]. teleomorphic synonym.

= *Penicillium* Link ex Gray *sensu* Pitt, The Genus *Penicillium*: 154. 1979 (nom. inval., art 13e). anamorphic synonym.

= *Chromocleista* Yaguchi & Udagawa, Trans. Mycol. Soc. Japan 34: 101. 1993, *vide* Houbraeken & Samson 2011. [MB25855]. teleomorphic synonym.



Fig. 1. A-B velvety colony of *P. persicinum* and *P. chrysogenum*. B: typical yellow crusts in *P. chrysogenum*. C: velvety colony of *P. commune* later becoming more fasciculate. D: large and compact conical heads of *P. brevicompactum*. E: floccose colony in *P. canadensis*. F: sphaeria in *P. olivati*. G-H: fasciculate colonies of *P. expansum*. I: crusts of conical masses of a 10 day old colony of *P. crustosum*. K-L: synchronous growth in *P. clavigerum* and *P. vulgatum*.

Виды с противоречивой морфологией

Penicillium paradoxum

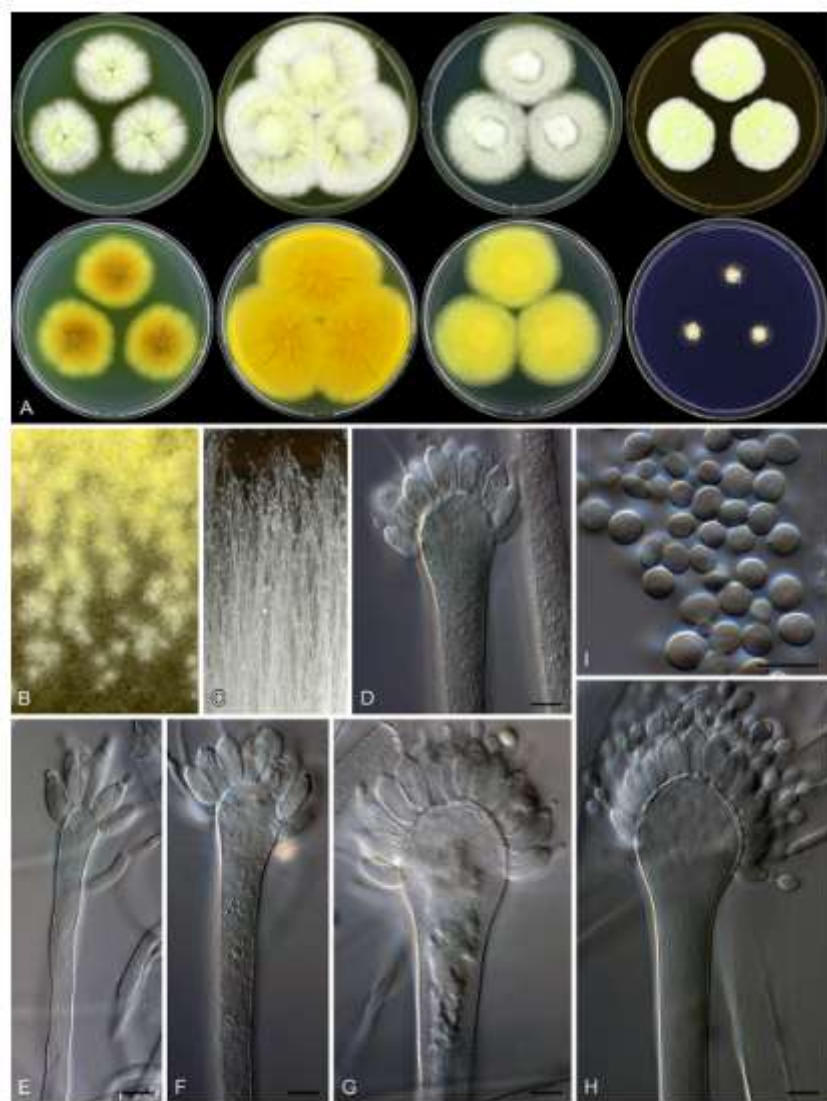


Fig. 3. *Penicillium paradoxum*. A. Colonies: top row left to right, obverse CYA, YES, DG18 and MEA; bottom row left to right, reverse CYA, reverse YES, reverse DG18 and OREA. B. Young sclerotia. C. Prototrophic conidiophores after two weeks growth. D-H. Conidiophores. I. Conidia. Scale bars: D-I = 10 μm.

Aspergillus inflatus

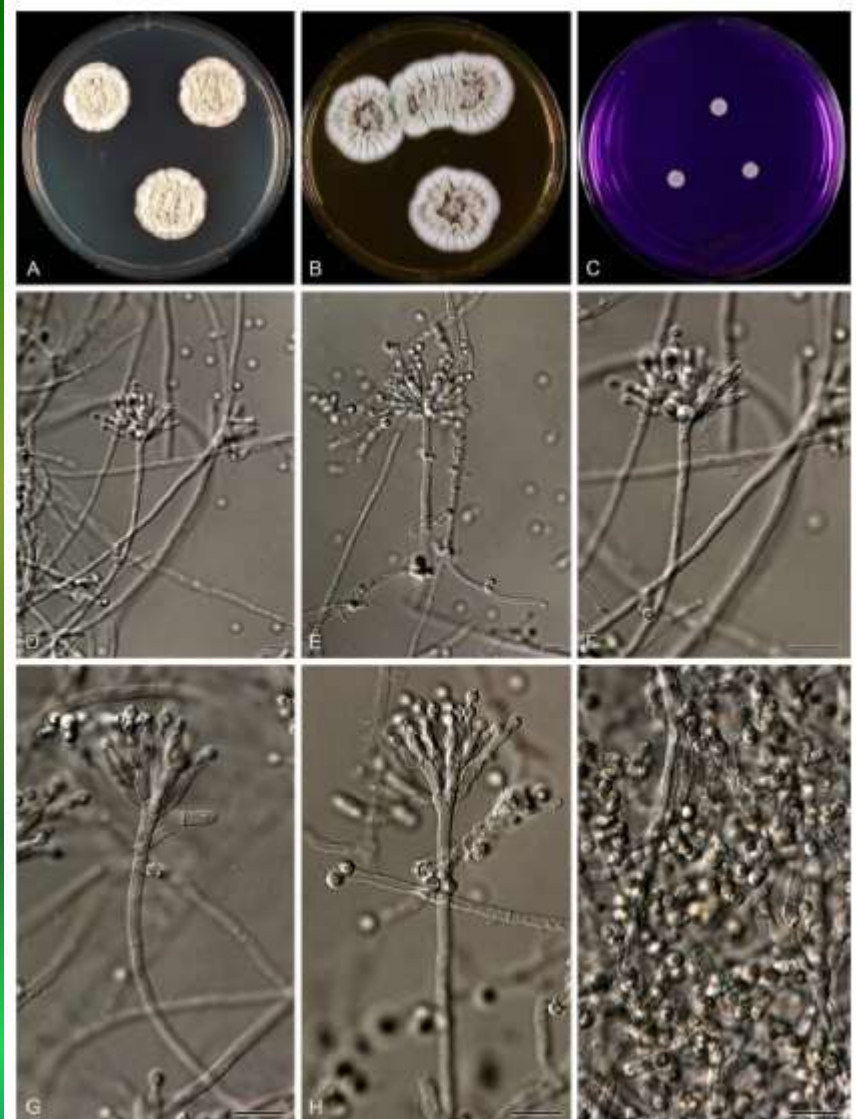


Fig. 5. *Aspergillus inflatus*. A. Colonies on CYA. B. Colonies on MEA. C. Colonies on OREA. D-H. Conidiophores. I. Conidia. Scale bars: D-I = 10 μm.

Yilmaz N, Visagie CM, Houbraken J, Frisvad JC, Samson RA (2014) Polyphasic taxonomy of the genus *Talaromyces*. *Studies in Mycology* 78: 175–341.

Talaromyces C.R. Benj., *Mycologia* 47: 681. 1955.

- = *Lasioderma* Mont. In *Ann. Sci. Nat., Bot.*, sér. 3, 4: 364. 1845, *nom. rej. prop.*
- = *Penicillium* Link subgenus *Biverticillium* Dierckx *apud* Biourge *Cellule* 33: 31. 1923.
- = *Penicillium* subg. *Biverticillata-Symmetrica* Thom, *The Penicillia*: 158. 1930.
- = *Sagenoma* Stolk & G.F. Orr, *Mycologia* 66: 676. 1974.
- = *Erythrogymnotheca* Yaguchi & Udagawa, *Mycoscience* 35: 219. 1994.
- = *Paratalaromyces* Matsush., *Matsush. Mycol. Mem.* 10: 111. 2003 (2001).

Typus: *T. vermiculatus* (P.A. Dang.) C.R. Benj. (= *Talaromyces flavus* (Klöcker) Stolk & Samson)

Colonies on CYA commonly produce yellow or red reverse and/or soluble pigments, on CYAS no growth to very restricted growth, sometimes determinate or indeterminate synnemata produced. *Conidiophores* having smooth or rough-walled elements, characteristically symmetrically biverticillate, with a minor proportion having subterminal branches (in some species with a single subterminal lateral branch that afterwards repeats the branching pattern of the main axis), some species monoverticillate or with solitary phialides. *Stipes* usually hyaline, terminating in a whorl of *metulae* of 3–10, appearing symmetrical in face view. *Conidiogenous cells* phialidic, approximately equal length to *metulae*, typically acerose, rarely flask-shaped. *Conidia* aseptate, green *en masse*, in basipetal chains, usually ellipsoidal to fusiform, rarely globose to subglobose or ovoidal. *Ascospores* one-celled, ellipsoidal to globose, rarely smooth-walled, but often with spines and/or less commonly ridges, hyaline to yellow, occasionally red.

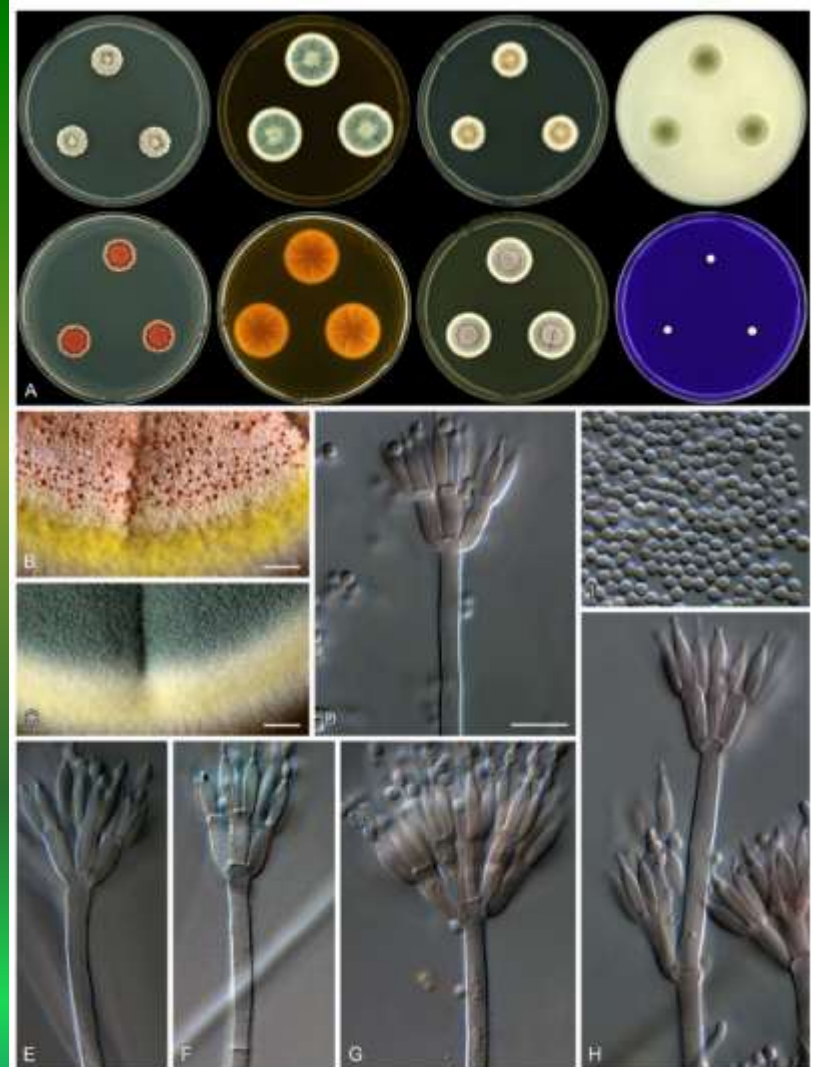


Fig. 11. Morphological characters of *Talaromyces abditiverticillus* (CBS 298.89). A. Colonies from left to right (top row) CYA, MEA, DG18 and CA, (bottom row) CYA reverse, MEA reverse, YES and CREA. B. Colony texture on MEA after 1 wk incubation (CBS 113442^T). C. Colony texture on MEA after 1 wk incubation (CBS 298.89). D–H *Conidiophores*. I. *Conidia*. Scale bars: B, C = 500 µm; D = 10 µm; applies to E–I.

Секции рода *Talaromyces*

Table 2. Overview of sectional classification in different studies of *Talaromyces*.

Stolk & Samson (1972)		Pitt (1980)		Current study	
Section	Type species	Section/Series	Type species	Section	Type species
<i>Talaromyces</i> sect. <i>Emersonii</i>	<i>T. emersonii</i>	<i>Penicillium</i> subgenus <i>Biverticillium</i> sect. <i>Coremigenum</i> ser. <i>Dendritica</i>	<i>P. dendriticum</i>	sect. <i>Bacillispori</i>	<i>T. bacillisporus</i>
<i>Talaromyces</i> sect. <i>Purpurea</i>	<i>T. purpureus</i>	<i>Penicillium</i> subgenus <i>Biverticillium</i> sect. <i>Coremigenum</i> ser. <i>Duclauxii</i>	<i>P. duclauxii</i>	sect. <i>Helici</i>	<i>T. helicus</i>
<i>Talaromyces</i> sect. <i>Talaromyces</i>	<i>T. flavus</i> (= <i>T. vermiculatus</i>)	<i>Talaromyces</i> sect. <i>Purpureus</i> ser. <i>Purpurei</i>	<i>T. purpureus</i>	sect. <i>Islandici</i>	<i>T. islandicus</i>
<i>Talaromyces</i> sect. <i>Thermophila</i>	<i>T. thermophilus</i>	<i>Penicillium</i> sect. <i>Simplicium</i> ser. <i>Islandica</i>	<i>P. islandicum</i>	sect. <i>Purpurei</i>	<i>T. purpureus</i>
		<i>Penicillium</i> sect. <i>Simplicium</i> ser. <i>Miniolutea</i>	<i>P. minioluteum</i>	sect. <i>Subinflati</i>	<i>T. subinflatus</i>
		<i>Talaromyces</i> sect. <i>Talaromyces</i> ser. <i>Flavi</i>	<i>T. flavus</i>	sect. <i>Talaromyces</i>	<i>T. flavus</i>
		<i>Talaromyces</i> sect. <i>Talaromyces</i> ser. <i>Lutei</i>	<i>T. luteus</i>	sect. <i>Trachyspermi</i>	<i>T. trachyspermus</i>
		<i>Talaromyces</i> sect. <i>Talaromyces</i> ser. <i>Trachyspermi</i>	<i>T. trachyspermus</i>		
		<i>Talaromyces</i> sect. <i>Thermophilus</i> ser. <i>Thermophili</i>	<i>T. thermophilus</i>		

Ascomycota, Pezizomycotina, Eurotiomycetes,
Eurotiomycetidae, Eurotiales,
Aspergillaceae Trichocomaceae

Aspergillus

Mycobank — 1072 записей
Index Fungorum — 983 записей
Species Fungorum — 741
известных видов и разновидностей
ICPA — **339** принятых видов
(Samson et al. 2014)

Penicillium

Mycobank — 1390
Index Fungorum — 1259
Species Fungorum — 880
ICPA — **354** (Visagie et al. 2014)

Talaromyces

Mycobank — 167
Index Fungorum — 148
Species Fungorum — 191
ICPA — **88** (Yilmaz et al. 2014)



Рекомендованный алгоритм идентификации видов *Aspergillus*

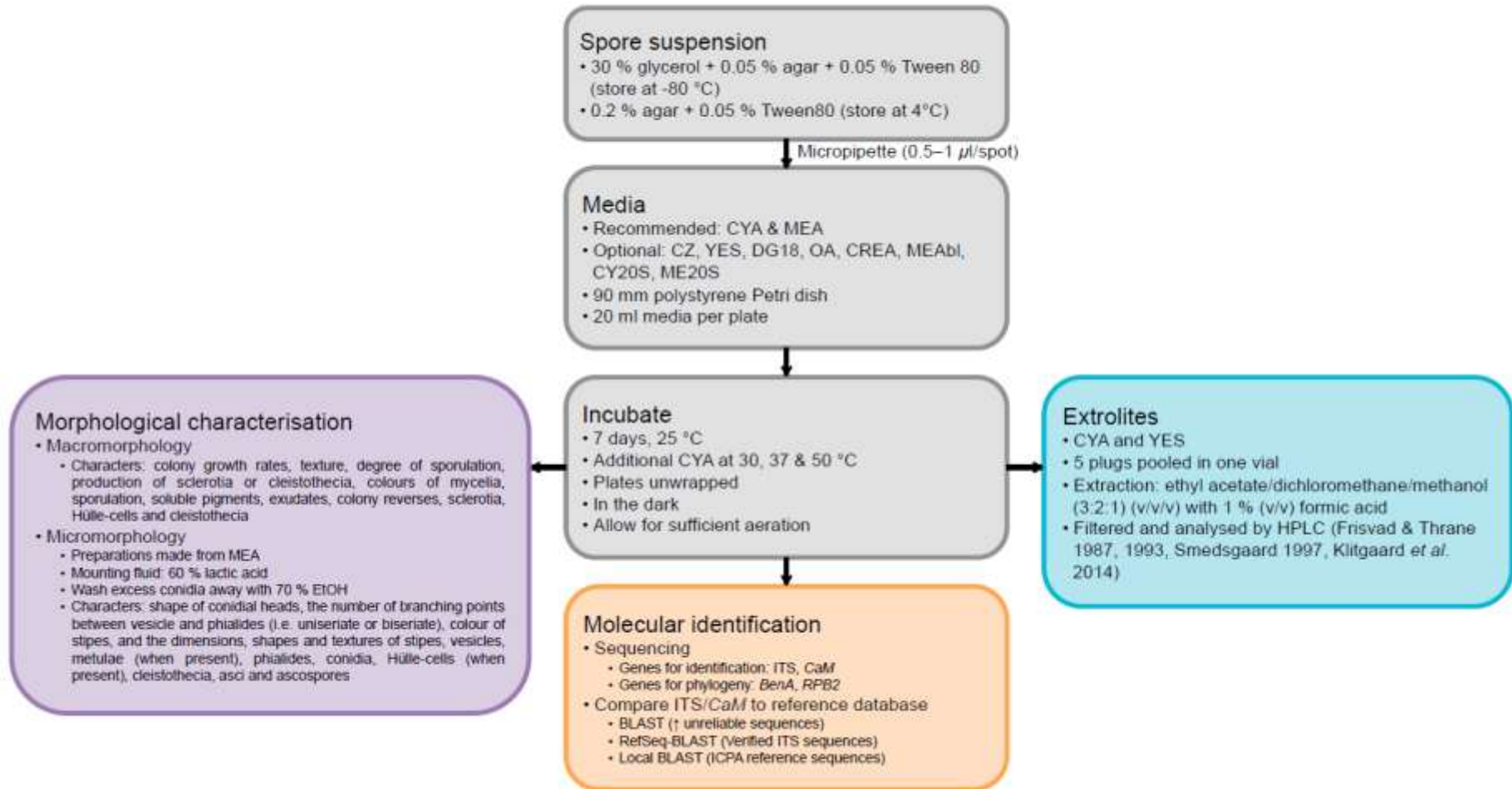


Fig. 2. Flow diagram summarising recommended methods for the identification and characterisation of *Aspergillus*. Frisvad & Thrane (1987, 1993), Smedsgaard (1997) and Klitgaard *et al.* (2014), refer to methods described for detecting extrolites in fungi.

Рекомендованный алгоритм идентификации видов *Penicillium*

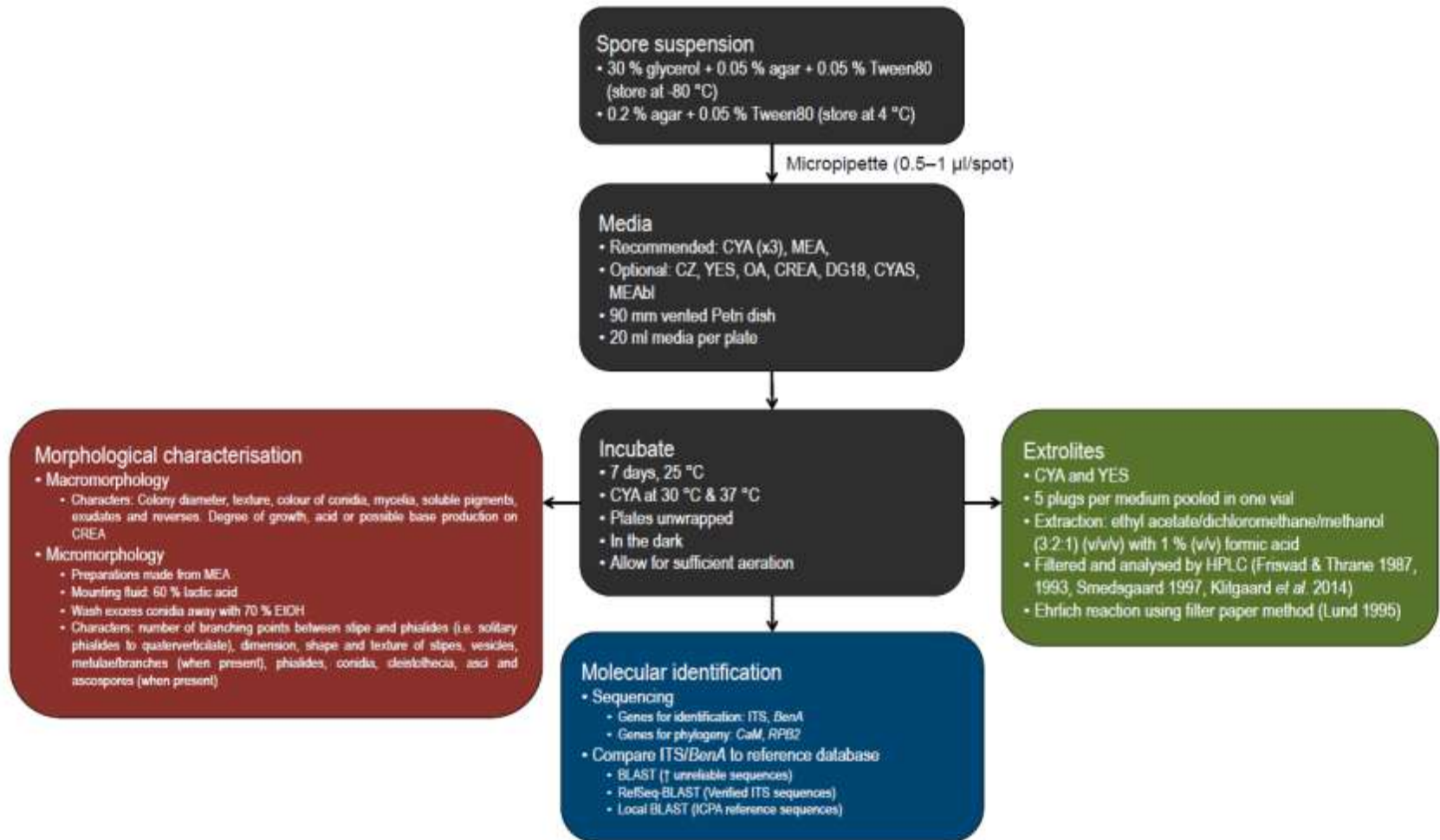


Fig. 1. Flow diagram summarising recommended methods for the identification and characterisation of *Penicillium*. Frisvad & Thrane (1987, 1993), Smedsgaard (1997) and Klitgaard *et al.* (2014), refer to methods described for detecting extrolites in fungi. Lund (1995) introduced the Ehrlich reaction that tests for production of indole metabolites.

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