Diversity and phylogeny of basidiomycetous yeasts from plant leaves and soil: Proposal of two new orders, three new families, eight new genera and one hundred and seven new species

A.-H. Li1,2, F.-X. Yuan3, M. Groenewald3, K. Bensch3, A.M. Yurkov3, K. Li1, P.-J. Han1, L.-D. Guo1, M.C. Aime4, J.P. Sampayo5,6,8, S. Jindamarakot8, B. Turchetti10, J. Inacio11, B. Fungsin12, Q.-M. Wang13,14, and F.-Y. Bai11

1State Key Laboratory of Mycology, Institute of Microbiology, Chinese Academy of Sciences, Beijing, 100101, China; 2China General Microbiological Culture Collection Center and State Key Laboratory of Microbial Resources, Institute of Microbiology, Chinese Academy of Sciences, Beijing, 100101, China; 3North Minzu University, Yinchuan, Ningxia, 750030, China; 4Westerdijk Fungal Biodiversity Institute, Uppsalalaan 8, Utrecht, 3584 CT, The Netherlands; 5Leibniz Institute DSMZ-German Collection of Microorganisms and Cell Cultures, Braunschweig, 38124, Germany; 6Purdue University, Department of Botany and Plant Pathology, West Lafayette, IN, 47906, USA; 7UCIBIO-REQUIMTE, Departamento de Ciências da Vida, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Caparica, Portugal; 8PYCC - Portuguese Yeast Culture Collection, Departamento de Ciências da Vida, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Caparica, Portugal; 9National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA), Pathum Thani, 12120, Thailand; 10Department of Agriculture, Food and Environmental Sciences & Industrial Yeasts Collection (DBVPG), University of Perugia, Perugia, 74 - 10612, Italy; 11School of Pharmacy and Biomolecular Sciences, University of Brighton, Brighton, BN2 4GJ, UK; 12TISTR Culture Collection, Thailand Institute of Scientific and Technological Research (TISTR), 35 M 3, Technopolis, Khlong Ha, Khlong Luang, Pathum Thani, 12120, Thailand; 13College of Life Sciences, Hebei University, Baoding, Hebei, China; 14Department of Agriculture, Food and Environmental Sciences & Industrial Yeasts Collection DBVPG, University of Perugia, Perugia, 74 - 10612, Italy

Abstract: Nearly 500 basidiomycetous yeast species were accepted in the latest edition of The Yeasts: A Taxonomic Study published in 2011. However, this number presents only the tip of the iceberg of yeast species diversity in nature. Possibly more than 99 % of yeast species, as is true for many groups of fungi, are yet unknown and await discovery. Over the past two decades nearly 200 unidentified isolates were obtained during a series of environmental surveys of yeasts in phyllophore and soils, mainly from China. Among these isolates, 107 new species were identified based on the phylogenetic analyses of nuclear ribosomal DNA (rDNA) [D1/D2 domains of the large subunit (LSU), the small subunit (SSU), and the internal transcribed spacer region including the 5.8S rDNA (ITS)] and protein-coding genes [both subunits of the mitochondrial gene cytochrome b (CYTB)], and physiological comparisons. Forty-six of these belong to 16 genera in the Tremellomyctina (Agaricomycotina). The other 61 are distributed in 26 genera in the Fusscinomycota. Here we circumscribe eight new genera, three new families and two new orders based on the multi-locus phylogenetic analyses combined with the clustering optimisation analysis and the predicted similarity thresholds for yeasts and filamentous fungal delimitation at genus and higher ranks. Additionally, as a result of these analyses, three new combinations are proposed and 66 taxa are validated.

Key words: Basidiomycetous yeasts, Molecular phylogeny, Species diversity, Taxonomy. Taxonomic novelties: New orders: Heilmaniales Q.M. Wang & F.Y. Bai, Rossettozymales Q.M. Wang & F.Y. Bai; New families: Heilmaniaceae Q.M. Wang & F.Y. Bai, Jianyuniaceae Q.M. Wang & F.Y. Bai, Rossettozymaceae Q.M. Wang & F.Y. Bai; New genera: Begerowomyces Q.M. Wang & F.Y. Bai, Boekhoutia Q.M. Wang & F.Y. Bai, Meniscozyma Q.M. Wang & F.Y. Bai, Pseudosterigmatospora Q.M. Wang & F.Y. Bai, Robertzyma Q.M. Wang & F.Y. Bai, Sterigmatospora Q.M. Wang & F.Y. Bai, Truncinia Q.M. Wang & F.Y. Bai; New species: Begerowomyces fellijicus Q.M. Wang, F.Y. Bai & A.H. Li, Bensingtonia wuzhishanensis Q.M. Wang, F.Y. Bai & A.H. Li, Boekhoutia stigmatica Q.M. Wang, F.Y. Bai & A.H. Li, Bullenbasidium cremeum Q.M. Wang, F.Y. Bai & A.H. Li, Bullenbasidium elongatum Q.M. Wang, F.Y. Bai & A.H. Li, Bullenbasidium phyllophilum Q.M. Wang, F.Y. Bai & A.H. Li, Bullenbasidium polysaccharoides Q.M. Wang, F.Y. Bai & A.H. Li, Carlsorossea saimoensis Q.M. Wang, F.Y. Bai & A.H. Li, Chrysozyma cylindrica Q.M. Wang, F.Y. Bai & A.H. Li, Chrysozyma flavia Q.M. Wang, F.Y. Bai & A.H. Li, Chrysozyma fusiformis Q.M. Wang, F.Y. Bai & A.H. Li, Chrysozyma inquisita Q.M. Wang, F.Y. Bai & A.H. Li, Chrysozyma pseudogriseoflavata Q.M. Wang, F.Y. Bai & A.H. Li, Chrysozyma rhodendrini Q.M. Wang, F.Y. Bai & A.H. Li, Chrysozyma sambuicola Q.M. Wang, F.Y. Bai & A.H. Li, Colacogloea alethidis Q.M. Wang, F.Y. Bai & A.H. Li, Colacogloea hydreae Q.M. Wang, F.Y. Bai & A.H. Li, Cystobasidium rhaffphilum Q.M. Wang, F.Y. Bai & A.H. Li, Cystobasidium tenuicola Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces bifurcus Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces elongatus Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces longyicladicus Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces novoformis Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces ovatus Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces polymorphus Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces taiwanicus Q.M. Wang, F.Y. Bai & A.H. Li, Derxomyces xingshanicus Q.M. Wang, F.Y. Bai & A.H. Li, Dioszegia heilongjiangensis Q.M. Wang, F.Y. Bai & A.H. Li, Dioszegia kandeliae Q.M. Wang, F.Y. Bai & L.D. Guo & A.H. Li, Dioszegia mactaeinis Q.M. Wang, F.Y. Bai & A.H. Li, Dioszegia milonica Q.M. Wang, F.Y. Bai & A.H. Li, Dioszegia ovata Q.M. Wang, F.Y. Bai & A.H. Li, Filobasidium diringiensie Q.M. Wang, F.Y. Bai & A.H. Li, Filobasidium globosum Q.M. Wang, F.Y. Bai & A.H. Li, Filobasidium mali Q.M. Wang, F.Y. Bai & A.H. Li, Filobasidium mucilaginum Q.M. Wang, F.Y. Bai & A.H. Li, Genwelvinia pseudosamyfolicta Q.M. Wang, F.Y. Bai & A.H. Li, Heilmania cylindrica Q.M. Wang, F.Y. Bai & A.H. Li, Heilmania tridentata Q.M. Wang, F.Y. Bai & A.H. Li, Holtermannia saccardii Q.M. Wang, F.Y. Bai & A.H. Li, Kockovella inphiens Q.M. Wang, F.Y. Bai & A.H. Li, Kockovella ischiari Q.M. Wang, F.Y. Bai & A.H. Li, Kockovella nitrophila Q.M. Wang, F.Y. Bai & A.H. Li, Konoba arboricola Q.M. Wang, F.Y. Bai & A.H. Li, Konoba chamaenerii Q.M. Wang, F.Y. Bai & A.H. Li, Konoba cylindrica Q.M. Wang, F.Y. Bai & A.H. Li, Konoba dalianiensis Q.M. Wang, F.Y. Bai & A.H. Li, Konoba folicina Q.M. Wang, F.Y. Bai & A.H. Li, Konoba jilangica Q.M. Wang, F.Y. Bai & A.H. Li, Konoba myxariophila Q.M. Wang, F.Y. Bai & A.H. Li, Konoba rhododendri Q.M. Wang, F.Y. Bai & A.H. Li, Konoba ribtophila Q.M. Wang, F.Y. Bai & A.H. Li, Kwoniiella ovata Q.M. Wang, F.Y. Bai & A.H. Li, Meniscozyma layuenensis Q.M. Wang, F.Y. Bai & A.H. Li, Microbotryozyma swertiae Q.M. Wang, F.Y. Bai & A.H. Li, Microsporomyces elliptococcus Q.M. Wang, F.Y. Bai & A.H. Li, Microsporomyces pseudomagnisporus Q.M. Wang, F.Y. Bai & A.H. Li, Microsporomyces rubellus Q.M. Wang, F.Y. Bai & A.H. Li, Oberwinkleromyces dicranopteridis Q.M. Wang, F.Y. Bai & A.H. Li, Oberwinkleromyces nepetae Q.M. Wang, F.Y. Bai & A.H. Li, Pheatothelia lactea Q.M. Wang, F.Y. Bai & A.H. Li, Pheatothelia ovata Q.M. Wang, F.Y. Bai & A.H. Li, Phaffia aurantiaca Q.M. Wang, F.Y. Bai & A.H. Li

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Basidiomycetous yeasts are fungi that can be characterized by unicellular growth for all or the majority of their life cycles (Boekhout et al. 2011). These occur in all three subphyla of Basidiomycota, namely Agaricomycotina, Puccinio- mycotina and Ustilaginomycotina (Bauer et al. 2006, Hibbett et al. 2007, Boekhout et al. 2011). Two hundred and twenty-four basidiomycetous yeast species belonging to 39 genera were included in the fourth edition of The Yeasts, a Taxonomic Study (Kurtzman & Fell 1998). That number more than doubled in the next twelve years to 463 species distributed in 82 genera in the fifth edition (Kurtzman et al. 2011). This increase in new species and genera has largely been driven by the advent of ribosomal DNA (rDNA) gene sequence analyses to yeast identification (Nakase 2000, Fell et al. 2000, Scorzetti et al. 2002) and the availability of databases containing sequence data of the D1/D2 domains of the large subunit of rDNA (LSU rDNA) and the ITS (including 5.8S) region of rDNA of most of the known basidiomycetous yeast species.

However, these studies also demonstrated that many genera of basidiomycetous yeasts have been revised. For example, the adoption of the availability of databases containing sequence data of the D1/D2 domains of the large subunit of rDNA (LSU rDNA) and the ITS (including 5.8S) region of rDNA of most of the known basidiomycetous yeast species. For instance, in the previous edition of the taxonomy, the genera Saccharomyces and Pichia were considered synonyms due to their close genetic relationships. However, subsequent studies using rDNA sequence analysis showed that these genera are distinct and warrant independent recognition.

Moreover, the availability of high-throughput sequencing technologies has enabled the discovery of many new species of basidiomycetous yeasts. These technologies allow for the rapid generation of large amounts of sequence data, which can then be used to identify novel species. As a result, the number of described basidiomycetous yeast species continues to increase. For example, the genus Rhodosporidium was recently expanded to include several new species, each with unique genetic characteristics.

In conclusion, the taxonomy of basidiomycetous yeasts has undergone significant changes in recent years due to advancements in molecular techniques. These changes have led to the recognition of new species and genera, and the revision of existing ones. The availability of rDNA sequence data has been instrumental in these revisions, enabling a more accurate classification of basidiomycetous yeasts. As our understanding of these fungi continues to grow, it is likely that further revisions and new species descriptions will be forthcoming.
2015a,b, Wang & Wang 2015). Vu et al. (2016) indicated that the above revision of basidiomycetous yeasts was a significant improvement in the generic taxonomy, although in a few cases the generic boundaries may still be too broadly defined.

It seems clear that there are still many gaps in our understanding of the yeast phylogeny and diversity. Mycologists have estimated that ca. 1 % fungal species have been described (Hawksworth 1991, 2001, Blackwell 2011, Hawksworth & Lücking 2017). Similar estimates exist for yeasts, indicating that ca. 12 000 undescribed yeast species await discovery (Lachance 2006), and there is ample evidence that many of these may reside in forests (Fonseca & Inácio 2006, Morais et al. 2006, Nakase et al. 2006). For example, more than 100 unknown yeast species in forests of Thailand have not yet been described (Nakase et al. 2006).

During a survey of the basidiomycetous yeast diversity in forests, mostly in China, more than 1 000 isolates including 180 strains representing potential novel species were isolated and examined over the past 20 years. In this study, 107 new basidiomycetous yeast species in Agaricomycotina and Pucciniomycotina are described based on phylogenetic analyses of multiple loci: three nuclear rDNA genes—the small subunit rDNA (SSU), the D1/D2 domains of the large subunit rDNA (LSU), and the internal transcribed spacer including the 5.8S rDNA (ITS)—and four protein coding genes—the largest subunit of RNA polymerase II (RPB1), the second largest subunit of RNA polymerase II (RPB2), translation elongation factor 1-α (TEF1) and the mitochondrial gene cytochrome b (CYTB), and on phenotypic properties. Based on these results, eight new genera, three new families and two new orders are proposed.

### MATERIALS AND METHODS

#### Strains and phenotypic characterisation

The strains studied are listed in Table 1. Strains were isolated from plant leaves by using the ballistoconidia-fall method as described by Nakase & Takashima (1993). Strains were isolated from soil by an enrichment method: one gram of each sample was plated into 10 ml Yeast Malt (YM, 0.3 % yeast extract, 0.3 % malt extract, 0.5 % peptone, 1 % glucose, Difco) broth containing 200μg/ml chloramphenicol in 15-ml conical tubes and cultured 3–7 d at 17 °C. Then enrichment samples were diluted to 1*10–3 or 1*10–4 and 200 μL of each dilution was plated on potato dextrose agar (PDA, 20 % potato infusion, 2 % glucose, 2 % agar, Difco) plates at 17 °C for 3–5 d to culture and isolate yeast strains. Morphological, physiological and biochemical characteristics were examined according to standard methods (Kurtzman et al. 2011). The potential sexual cycles of all new species were investigated using YM, PDA, V8 (10 % V8 juice, 2 % agar) and corn meal agar (CM, 5 % infusion corn meal, 1.5 % agar, Difco). A loopful of cells of each test strain is mixed on an agar plate incubated at 17 °C for one or two months. The cultures were examined with a microscope for the presence of filaments and sexual structures every two weeks. The ballistoconidium-forming activity of all new species was observed by the inverted-plate method (do Carmo-Sousa & Pfaff 1962) using CM agar at 17 °C. After 3 to 14 d, the glass slide containing the discharged spores was removed for examination under the microscope.

### DNA extraction and ribosomal DNA sequencing

Nuclear DNA was extracted using the method described previously by Wang & Bai (2008). The ITS (including 5.8S rDNA region and LSU rDNA D1/D2 domains) were sequenced using the methods described previously (Wang & Bai 2004). The small subunit (SSU) rDNA sequences were determined according to Wang et al. (2003). The CYTB sequences were performed as described by Wang & Bai (2008). The three nuclear protein-coding genes, RPB1, RPB2 and TEF1, were obtained using methods described previously (Wang et al. 2014). GenBank accession numbers for all sequences determined in this study are listed in Table 1.

Sequences were aligned with the MAFFT program (Standley 2013) using the G-INS-I algorithm and minor gaps in all alignments were manually deleted. The most appropriate model of DNA substitution was searched with Modeltest version 3.04 (Posada & Crandall 1998) using the Akaike information criterion (AIC). The model GTR + I + G was selected for Maximum likelihood (ML) and Bayesian inference (BI) analyses. ML analysis was conducted using RAxML-HPC 7.2.8 (Stamatakis 2006) with 1 000 bootstrap replicates. BI analysis was conducted using MrBayes 3.1.2 (Ronquist et al. 2012) with 10 000 000 generations using the parameter settings described previously (Wang et al. 2015a). A bootstrap percentage (BP) of >70 % or a Bayesian posterior probability (PP) of >0.9 was considered as significantly supported in all constructed trees in this study. The alignments and trees were deposited in TreeBASE (www.treebase.org, Nos. 24640–24646).

### New species catalogised

New accurate identification of known yeast species and rapid detection of new species are currently possible because of the availability of ITS and D1/D2 sequence databases for most of the known yeasts (Kurtzman & Robnett 1998, Fell et al. 2000, Scorzet et al. 2002, Boekhout et al. 2011, Kurtzman 2014, Liu et al. 2015a, Wang et al. 2015a, Vu et al. 2016). Recently The Yeasts Trust announced, a new yeasts database (Boekhout et al. 2016, http://theyeasts.org/) which provides the most up-to-date and accurate taxonomic information including DNA sequences and phenotypic characteristics on all published yeasts. Vu et al. (2016) recommended that the similarity thresholds to discriminate a yeast species were 1.59 % (or 0.79 % using ex-type strains only) and 0.49 % for ITS and D1/D2, respectively, based on the barcode data of ca. 9 000 yeast strains, which are in agreement with previous studies (Kurtzman & Robnett 1998, Fell et al. 2000, Scorzet et al. 2002) that indicated sequence diversity among conspecific strains is less than 1 % in either the ITS or D1/D2 regions (Kurtzman & Fell 2006, Kurtzman 2014, 2015, Kurtzman et al. 2015). However, delineation of species using single region sequence is not always reliable for yeasts, especially for basidiomycetous yeasts, because different lineages may vary in their rates of nucleotide substitution for the diagnostic gene being used (Fell et al. 2000, Scorzet et al. 2002). Thus, a combined sequence analysis of the D1/D2 domains and ITS region is recommended for species identification by Scorzet et al. (2002) and Kurtzman & Fell (2006). Consequently, sequence analyses of both D1/D2 and ITS were used to differentiate the potentially new species and their closely related species in this study. In order to improve the species delimitation,
Table 1. List of yeasts employed and GenBank numbers determined in this study.

| Species                          | Strain                        | Date          | Location                        | Source                  | 18S+ITS+D1/D2 | RPB1          | RPB2          | TEF1          | CYTB          |
|----------------------------------|-------------------------------|---------------|---------------------------------|-------------------------|---------------|---------------|---------------|---------------|---------------|
| Kockovaella haikouensis sp. nov. | CGMCC 2.3443T = HKX2 = CBS 15478 | November 14, 2006 | Haikou county, Hainan province, China | phylloplane             | MK050274      | MK849163      | MK849301      | MK849032      | MK848902      |
|                                  | CGMCC 2.3444 = KX4           | November 14, 2006 | Haikou county, Hainan province, China | phylloplane             | MK050275      | –             | –             | –             | –             |
| K. ischaemi sp. nov.             | CGMCC 2.3565T = JH5.17 = CBS 15500 | November 15, 2006 | Jinghong, Yunnan province, China | leaf of *Ischaemum* sp. | MK050276      | MK849185      | MK849323      | –             | –             |
|                                  | CGMCC 2.3536 = JF5.5-2 = CBS 15496 | November 15, 2006 | Jianfailing, Hainan province, China | phylloplane             | MK050277      | MK849182      | MK849320      | –             | –             |
| K. nitrophila sp. nov.           | CGMCC 2.3465T = WZS12.1 = CBS 15487 | November 16, 2006 | Wuzhishan mountain, Hainan province, China | phylloplane             | MK050278      | MK849173      | –             | MK849043      | MK848913      |
| Genolevuria pseudoamyloiytica sp. nov. | CGMCC 2.5809T = HLJ1B6 = CBS 13955 | August 23, 2014 | Daliangzi river national forest park, Heilongjiang province, China | phylloplane             | MK050279      | MK849257      | MK849394      | MK849118      | –             |
| Vishniacozyma europaea sp. nov.  | CGMCC 2.3099T = G7.1-2 = CBS 15464 | September 20, 2005 | Germany                         | phylloplane             | MK050335      | MK849148      | –             | MK849018      | MK848890      |
| V. pseudoplenaus sp. nov.        | CGMCC 2.3165T = G7.20 = CBS 15472 | September 20, 2005 | Germany                         | phylloplane             | MK050333      | MK849155      | –             | MK849025      | MK848897      |
|                                  | CGMCC 2.3182 = G7.14          | September 20, 2005 | Germany                         | phylloplane             | MK050334      | MK849158      | –             | MK849028      | MK848898      |
|                                  | CBS 8412                      | 1996           | Netherlands                     | brine bath in cheese factory | AY250757/CBS Database | –             | –             | –             | –             |
| V. melezitolytica sp. nov.       | CBS 9328                      | April 15, 1995 | Carapa, Costa Rica             | soil                    | CBS Database   | –             | –             | –             | –             |
|                                  | CGMCC 2.3472T = H5A3 = CBS 15490 | April 16, 2007 | Hebei province, China           | phylloplane             | MK050330      | MK849177      | MK849315      | MK849046      | –             |
| Saitozyma pseudoflava sp. nov.   | CGMCC 2.3105 = G18.1 = CBS 15467 | September 20, 2005 | Germany                         | phylloplane             | MK050331      | –             | –             | –             | –             |
|                                  | CGMCC 2.3166 = G18.11         | September 20, 2005 | Germany                         | phylloplane             | MK050332      | MK849156      | MK849295      | MK849026      | –             |
| Carlosozysa follicola sp. nov.   | CGMCC 2.5811T = XZ200A1 = CBS 15576 | September 22, 2014 | Tibet, China                    | phylloplane             | MK050284      | MK849251      | MK849387      | MK849114      | MK848887      |
|                                  | CGMCC 2.3447T = WZS29.4 = CBS 15481 | November 6, 2006 | Wuzhishan mountain, Hainan province, China | phylloplane             | MK050282      | MK849166      | MK849304      | –             | MK848905      |
| C. simaoensis sp. nov.           | CGMCC 2.3580T = SM8.1 = CBS 15503 | November 14, 2006 | Simao county, Yunnan province, China | phylloplane             | MK050283      | MK849188      | MK849326      | MK849056      | MK848924      |
| Tremella shuangheensis sp. nov.  | CGMCC 2.5615T = SH58A1 = CBS 15561 | August 20, 2015  | Shuanghe county, Heilongjiang province, China | phylloplane             | MK050285      | MK849223      | MK849362      | MK849087      | MK848956      |
| Species                      | Strain                  | Date           | Location                        | Source              | 18S+ITS+D1/D2 | RPB1    | RPB2    | TEF1    | CYTB    |
|------------------------------|-------------------------|----------------|---------------------------------|---------------------|--------------|---------|---------|---------|---------|
| Kwoniella ovata sp. nov.     | CGMCC 2.3439<sup>T</sup> = H1C1 = CBS 15475 | November 6, 2006 | Hebei province, China           | phylloplane         | MK050289    | MK849160 | MK849298 | MK849030 | MK848899 |
| Teunia korlaensis sp. nov.   | CGMCC 2.3835<sup>T</sup> = 141.19 = CBS 15653 | February 21, 2008 | Kuerlei county, Xinjiang province, China | soil                | MK050286    | MK849194 | MK849332 | –        | MK848929 |
| T. helanensis sp. nov.       | CGMCC 2.4450<sup>T</sup> = HLS02-1-5 = CBS 12498 | August 21, 2009 | Helanshan mountain, Ningxia province, China | soil                | MK050287    | MK849208 | MK849347 | MK849074 | MK848942 |
| T. globosa sp. nov.          | CGMCC 2.5648<sup>T</sup> = GPS23.2A6 = CBS 15566 | September 22, 2015 | Lulang county, Tibet, China     | phylloplane         | MK050288    | MK849235 | MK849374 | MK849100 | –        |
| Dioszegia milinica sp. nov.  | CGMCC 2.5628<sup>T</sup> = GPS21.3B8 = CBS 15563 | September 21, 2015 | Min county, Tibet, China    | phylloplane         | MK050290    | MK849231 | MK849371 | MK849097 | MK848966 |
| D. heilongjiangensis sp. nov.| CGMCC 2.5674<sup>T</sup> = HLJ13.24 = CBS 13957 | August 28, 2014 | Cheu county, Heilongjiang province, China | phylloplane         | MK050291    | MK849245 | MK849382 | MK849109 | MK848981 |
|                              | CGMCC 2.5662 = HLJ41A9 = CBS 13966 | August 26, 2014 | Wuyiling natural reserve, Heilongjiang province, China | phylloplane         | MK050292    | MK849243 | MK849380 | MK849106 | MK848978 |
|                              | CGMCC 2.5672 = HLJ41A9B | August 26, 2014 | Wuyiling natural reserve, Heilongjiang province, China | phylloplane         | MK050293    | –        | –        | –        | –        |
| D. ovata sp. nov.            | CGMCC 2.3625<sup>T</sup> = HBX1.27 = CBS 15657 | November 24, 2006 | Bangxi county, Hainan province, China | phylloplane         | MK050294    | MK849190 | MK849328 | –        | MK848926 |
| D. maotaiensis sp. nov.      | CGMCC 2.4537<sup>T</sup> = GZMT3A9 = CBS 15516 | March 8, 2012 | Maotai county, Guizhou province, China | phylloplane         | MK050295    | MK849210 | MK849350 | MK849076 | MK848945 |
| D. kandeliae sp. nov.        | CGMCC 2.5658<sup>T</sup> = 224191 = CBS 13951 | April 15, 2014 | Beilunhekou natural reserve, Guangxi province, China | leaf of Kandelia candel | MK050296    | MK849241 | MK849378 | MK849104 | MK848976 |
| Bullenbasidium pseudopanici sp. nov. | CGMCC 2.4024<sup>T</sup> = WZS17.20 = CBS 15510 | November 22, 2006 | Wuzhishan mountain, Hainan province, China | phylloplane         | MK050323    | MK849197 | MK849336 | MK849062 | MK848932 |
|                              | CGMCC 2.4022 = WZS29.3 | November 16, 2006 | Wuzhishan mountain, Hainan province, China | phylloplane         | MK050324    | MK849196 | MK849335 | MK849061 | –        |
| B. cremeum sp. nov.          | CGMCC 2.4427<sup>T</sup> = TW1.1F-025 = CBS 12487 | August 18, 2009 | Taiwan, China | phylloplane         | MK050325    | MK849198 | MK849337 | MK849064 | MK848933 |

(continued on next page)
| Species                     | Strain                  | Date              | Location           | Source                          | 18S+ITS+D1/D2 | RPB1   | RPB2   | TEF1 | CYTB |
|-----------------------------|-------------------------|-------------------|--------------------|---------------------------------|---------------|--------|--------|------|------|
| *B. phyllostachydis* sp. nov. | CGMCC 2.5812T = XZ193E1 = CBS 15575 | September 20, 2014 | Motuo, Tibet, China | leaf of Phyllostachys sp.       | MK050327      | MK849261 | MK849398 | –    | MK848993 |
| *B. elongatum* sp. nov.     | CGMCC 2.4428T = TW1.1F-019 = CBS 12489 | August 18, 2009   | Taiwan, China      | phyloplane                      | MK050326      | MK849199 | MK849338 | MK849065 | MK848934 |
| *B. phylophilum* sp. nov.   | CGMCC 2.3320T = HBX2.8 = CBS 15474 | November 24, 2006 | Bangxi county, Hainan province, China | phyloplane | MK050328 | MK849195 | MK849334 | MK849060 | MK848931 |
|                          | CGMCC 2.4018 = HBX1.23 | November 24, 2006 | Bangxi county, Hainan province, China | phyloplane | MK050329 | –       | –      | –    | –    |
| **TY-199**                 |                         | 2003              | Thailand           | phyloplane                      | AY313030      | –       | –      | –    | –    |
| *Derxomyces pseudoboekhoutii* sp. nov. | CGMCC 2.4436T = FJYZ12-8 = CBS 12493 | August 18, 2011   | Fuzhou county, Fujian province, China | phyloplane | MK050310 | MK849202 | MK849341 | MK849068 | MK848937 |
| *D. polymorphus* sp. nov.  | CGMCC 2.4437T = FJYZ12-13 = CBS 15512 | August 18, 2011   | Fuzhou county, Fujian province, China | phyloplane | MK050309 | MK849203 | MK849342 | MK849069 | MK848938 |
| *D. xingshanicus* sp. nov. | CGMCC 2.2459T = HBX16.1 = CBS 15445 | July 7, 2003      | Xingshan county, Hubei province, China | phyloplane | MK050308 | MK849128 | MK849269 | MK849000 | MK848873 |
| *D. pseudoyunnanensis* sp. nov. | CGMCC 2.3563T = SM37E2 = CBS 15499 | November 10, 2006 | Simao county, Yunnan province, China | phyloplane | MK050313 | MK849184 | MK849322 | MK849052 | MK848921 |
|                           | CGMCC 2.3469 = WZS29.1B | November 16, 2006 | Wuzhishan mountain, Hainan province, China | phyloplane | MK050316 | MK849175 | MK849313 | MK849044 | MK848914 |
|                           | CGMCC 2.3568 = SM37.6 = CBS 15501 | November 14, 2006 | Simao county, Yunnan province, China | phyloplane | MK050314 | MK849186 | MK849324 | MK849053 | MK848922 |
|                           | CGMCC 2.3449 = WZS29.18 | November 16, 2006 | Wuzhishan mountain, Hainan province, China | phyloplane | MK050317 | –       | –      | –    | –    |
|                           | CGMCC 2.3468 = WZS29.1 = CBS 15484 | November 16, 2006 | Wuzhishan mountain, Hainan province, China | phyloplane | MK050315 | MK849169 | MK849307 | MK849037 | MK848907 |
|                           | TW1.1F026               | August 18, 2009   | Taiwan, China      | phyloplane                      | MK050318      | –       | –      | –    | –    |
| *D. longiovatus* sp. nov.  | CGMCC 2.3535T = SM35.4 = CBS 15659 | November 10, 2006 | Simao county, Yunnan province, China | phyloplane | MK050312 | MK849181 | MK849319 | MK849050 | MK848919 |
| *D. napiformis* sp. nov.   | CGMCC 2.4446T = TW1.1F028 = CBS 15748 | August 18, 2009   | Taiwan, China      | phyloplane                      | MK050321      | MK849207 | MK849346 | MK849073 | MK848941 |
|                           | TW1.1F05B               | August 18, 2009   | Taiwan, China      | phyloplane                      | MK050322      | –       | –      | –    | –    |
| *D. bifurcus* sp. nov.     | CGMCC 2.3470T = SM37.5 = CBS 15489 | November 16, 2006 | Simao county, Yunnan province, China | phyloplane | MK050319 | MK849176 | MK849314 | MK849045 | MK848915 |
| Species                | Strain                  | Date            | Location                                  | Source              | 18S+ITS+D1/D2 | RPB1      | RPB2      | TEF1      | CYTB      |
|------------------------|-------------------------|-----------------|-------------------------------------------|---------------------|---------------|-----------|-----------|-----------|-----------|
| D. elongatus sp. nov.  | CGMCC 2.3761 = SM37.15 = CBS 15508 | October 16, 2007 | Simao county, Yunnan province, China      | phylloplane         | MK050320      | –         | –         | –         | –         |
| D. melastomatis sp. nov. | CGMCC 2.3561 = SM32.1 = CBS 15498 | November 10, 2006 | Simao county, Yunnan province, China      | phylloplane         | MK050311      | MK849183   | MK849321   | MK849051   | MK848920   |
| D. taiwanicus sp. nov. | CGMCC 2.2429 = TW3.1C-02 = CBS 12490 | August 18, 2009  | Taiwan, China                             | phylloplane         | MK050303      | MK849200   | MK849339   | MK849066   | MK848935   |
| D. ovatus sp. nov.     | CGMCC 2.3560 = SM32.2 = CBS 15654 | November 10, 2006 | Simao county, Yunnan province, China      | phylloplane         | MK050302      | MK849167   | MK84955    | MK849823   | MK848977   |
| D. longicylindricus sp. nov. | CGMCC 2.5660 = XZ32E37A = CBS 13979 | September 21, 2014 | Beibeng county, Motuo, Tibet, China      | phylloplane         | MK050300      | MK849242   | MK849379   | MK849105   | MK848977   |
| Phaeotremella lactea sp. nov. | CGMCC 2.5810 = GPS20.4A1B = CBS 15574 | September 21, 2015 | Milin county, Tibet, China               | phylloplane         | MK050280      | MK849250   | –         | –         | MK848986   |
| P. ovata sp. nov.      | CGMCC 2.5614 = NW9D3 = CBS 15756 | August 20, 2015  | Nanwenghe, Heilongjiang province, China   | phylloplane         | MK050281      | MK849222   | MK849361   | –         | MK848949   |
| Holtermannia saccardoi sp. nov. | CGMCC 2.3445 = SM37.10 = CBS 15479 | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050336      | MK849164   | MK849302   | MK849033   | MK848903   |
|                        | CGMCC 2.3460 = SM6.3     | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050337      | MK849171   | MK849309   | MK849039   | MK848909   |
|                        | CGMCC 2.3462 = SM32.11   | November 6, 2006 | Simao county, Yunnan province, China      | phylloplane         | MK050338      | –         | MK849310   | MK849040   | MK848910   |
| Holtermannia saccardoi sp. nov. | CGMCC 2.3445 = SM37.10 = CBS 15479 | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050336      | MK849164   | MK849302   | MK849033   | MK848903   |
|                        | CGMCC 2.3460 = SM6.3     | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050337      | MK849171   | MK849309   | MK849039   | MK848909   |
| Holtermannia saccardoi sp. nov. | CGMCC 2.3445 = SM37.10 = CBS 15479 | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050336      | MK849164   | MK849302   | MK849033   | MK848903   |
|                        | CGMCC 2.3460 = SM6.3     | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050337      | MK849171   | MK849309   | MK849039   | MK848909   |
| Holtermannia saccardoi sp. nov. | CGMCC 2.3445 = SM37.10 = CBS 15479 | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050336      | MK849164   | MK849302   | MK849033   | MK848903   |
|                        | CGMCC 2.3460 = SM6.3     | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050337      | MK849171   | MK849309   | MK849039   | MK848909   |
| Holtermannia saccardoi sp. nov. | CGMCC 2.3445 = SM37.10 = CBS 15479 | November 6, 2006 | Simao county, Yunnan province, China      | leaf of Arisaema yunnanense | MK050336      | MK849164   | MK849302   | MK849033   | MK848903   |

(continued on next page)
| Species Strain | Date         | Location                                      | Source                                      | 18S+ITS+D1/D2   | RPB1    | RPB2    | TEF1    | CYTB    |
|----------------|--------------|-----------------------------------------------|---------------------------------------------|-----------------|---------|---------|---------|---------|
| Sollucozyma gelidoterrea sp. nov. CGMCC 2.5814T = HFB003 = CBS 15580 | August 15, 2015 | Wuzhishan mountain, Hainan province, China | soil                                      | MK050340        | MK849252 | MK849388 | –       | –       |
| CGMCC 2.4893T = LZ3.17.4 | October 12, 2012 | China                                           | soil                                      | MK050341        | MK849215 | MK849354 | MK849081 | MK848948 |
| DBVPG10727 | 2017         | Alps, Dolomites, Livigno, Italy                | bark of spruce                              | MK070335/MK070317 | –       | –       | –       | –       |
| CBS 9627 | November, 1981 | Colorado, Longs Peak, Rocky Mountain National Park, USA | soil                                      | KY105431/KY109663 | –       | –       | –       | –       |
| – | – | – | – | – | – | – | – | – |
| Filobasidium dingjense sp. nov. CGMCC 2.5649T = GPS3.2A5 = CBS 15567 | September 12, 2015 | Dingjie county, Tibet, China | phylloplane                                      | MK050342        | MK849236 | MK849375 | –       | MK848971 |
| GPS23.2A5 | September 22, 2015 | Lulang county, Tibet, China | phylloplane                                      | MK050343        | –       | –       | –       | –       |
| F. globosum sp. nov. CGMCC 2.5680T = HLJ8A3 = CBS 15658 | August 25, 2014 | Yichun county, Heilongjiang province, China | phylloplane                                      | MK050344        | MN014083 | MN014090 | MN014092 | MN014078 |
| CGMCC 2.5656 = HLJ8A3B | August 25, 2014 | Yichun county, Heilongjiang province, China | phylloplane                                      | MK050345        | MK849240 | MK849377 | –       | MK848975 |
| F. mali sp. nov. CGMCC 2.4012T = KTAPG4-11.46 = CBS 15651 | August 20, 2008 | Qufu county, Shandong province, China | leaf of apple (Malus pumila) | MK050346        | MK849333 | –       | –       | MK848930 |
| CGMCC 2.4052 = KTAPG1-11.63 | August 20, 2008 | Tai’an county, Shandong province, China | leaf of apple (Malus pumila) | MK050347        | –       | –       | –       | –       |
| CGMCC 2.3464 = WZS19.13 | November 16, 2006 | Wuzhishan mountain, Hainan province, China | leaf of Melastoma candidum | MK050348        | MK849172 | MK849312 | MK849042 | MK848912 |
| KTAPG4-11.64 | August 20, 2008 | Qufu county, Shandong province, China | leaf of apple (Malus pumila) | GO181171 | – | – | – | – |
| 4QVF20 = CBS 10181 | June, 1998 | Arrabida Natural Park, Portugal | Leaf of Quercus faginea | EU002869/EU002805 | – | – | – | – |
| F. mucilaginum sp. nov. CGMCC 2.3463T = SY2.1 = CBS 15486 | November 16, 2006 | Sanya county, Hainan province, China | phylloplane                                      | MK050349        | –       | MK849311 | MK849041 | MK848911 |
| Phaf fi aurantiaca sp. nov. CGMCC 2.5601T = GPS23.2A4 = CBS 15948 | September 22, 2015 | Lulang county, Tibet, China | phylloplane                                      | MK050350        | MN014085 | MN014089 | MN014091 | MN014077 |
| Species | Strain | Date | Location | Source | 18S+ITS+D1/D2 | RPB1 | RPB2 | TEF1 | CYTB |
|---------|--------|------|----------|--------|---------------|------|------|------|------|
| K. cylindrica sp. nov. | CGMCC 2.3102<sup>T</sup> = G6.1-1 = CBS 15466 | September 20, 2005 | Germany | phylloplane | MK050351 | MK849150 | MK849290 | MK849020 | MK848892 |
| | CGMCC 2.3103 = G4.22A | September 20, 2005 | Germany | phylloplane | MK050352 | MK849151 | MK849291 | MK849021 | MK848893 |
| | CGMCC 2.3175 = G4.22B | September 20, 2005 | Germany | phylloplane | MK050353 | MK849157 | MK849296 | MK849027 | – |
| | PYCC 5566 | 1998 | Sesimbra, Portugal | basidioecarp of Myxarium nucleatum | AF444672/AF444766 | – | – | – | – |
| K. chamaenerii sp. nov. | CGMCC 2.2852<sup>T</sup> = XJ8A5 = CBS 15453 | July 6, 2004 | Bujin county, Xinjiang province, China | leaf of Chamaenerion angustifolium | MK050354 | MK849135 | MK849275 | MK849005 | MK848878 |
| | CGMCC 2.2760 = XJ10A7 | July 6, 2004 | Bujin county, Xinjiang province, China | leaf of Cotoneaster melanocarpus | MK050355 | – | MK849278 | MK849007 | MK848880 |
| K. foliicola sp. nov. | CGMCC 2.3100<sup>T</sup> = G9.1 = CBS 15465 | September 20, 2005 | Germany | phylloplane | MK050356 | MK849262 | MK849399 | MK849120 | MK848994 |
| K. arboricola sp. nov. | CGMCC 2.2621<sup>T</sup> = XZ12B5 = CBS 15452 | September 21, 2004 | Bomi county, Tibet, China | leaf of arbor | MK050357 | MK849134 | MK849274 | – | – |
| | CGMCC 2.4886 = LWL4.17.24 | October 12, 2012 | China | soil | MK050358 | MK849214 | MK849353 | – | – |
| K. lulingica sp. nov. | CGMCC 2.2762<sup>T</sup> = XZ36D1 = CBS 15456 | September 21, 2004 | Lulang county, Tibet, China | phylloplane | MK050359 | MK849138 | MK849279 | MK849008 | MK848881 |
| K. rhododendri sp. nov. | CGMCC 2.2763<sup>T</sup> = XZ27E3 = CBS 15457 | September 21, 2004 | Bomi county, Tibet, China | leaf of Rhododendron triflorum | MK050360 | MK849139 | MK849280 | MK849009 | MK848882 |
| K. daliangziensis sp. nov. | CGMCC 2.5610<sup>T</sup> = HLJ22A8 = CBS 13974 | August 28, 2014 | Daliangzi river national forest park, Heilongjiang province, China | phylloplane | MK050361 | MK849220 | MK849359 | MK849085 | MK848954 |
| | HLJ14.20B = CBS 15577 | August 20, 2014 | Chelu county, Heilongjiang province, China | phylloplane | MK050362 | MK849256 | MK849393 | MK849117 | MK849890 |
| K. ribitophobia sp. nov. | CGMCC 2.4441<sup>T</sup> = TW2.1E-016 = CBS 12496 | August 17, 2009 | Taiwan, China | phylloplane | MK050363 | MK849204 | MK849343 | MK849070 | MK848939 |
| | CGMCC 2.4875 = HZ29D.2 | October 12, 2012 | Houzhenzi, Shaaxi province, China | phylloplane | MK050364 | MK849213 | MK849352 | MK849080 | – |
| K. myxariophila sp. nov. | CGMCC 2.3106 = G18.2-2 = CBS 15468 | September 20, 2005 | Germany | phylloplane | MK050365 | MK849152 | MK849292 | MK849022 | MK848894 |
| | AS483 = CBS 11525 | November, 2008 | Graubuenden Alp Flix, Switzerland | flower of Dianthus superbus | MN175324/FN428954 | – | – | – | – |

(continued on next page)
Table 1. (Continued).

| Species                        | Strain        | Date       | Location                  | Source                                                                 | 18S+ITS+D1/D2                  | RPB1 | RPB2 | TEF1 | CYTB |
|--------------------------------|---------------|------------|---------------------------|------------------------------------------------------------------------|--------------------------------|------|------|------|------|
| **Basidiocarps of *Myxarium**  |               |            |                           |                                                                        |                                |      |      |      |      |
| nucleatum                      | PYCC 5509T = CBS 8379 = ZP 337 | 1992       | Portugal                  | basidiocarps of *Myxarium* nucleatum                                   | MN175325                       | –    | –    | –    | –    |
| nucleatum                      | PYCC 8354 = ZP 338 | 1992       | Portugal                  | basidiocarps of *Myxarium* nucleatum                                   | MN175326                       | –    | –    | –    | –    |
| nucleatum                      | PYCC 8305 = ZP 352 | 1996       | Portugal                  | basidiocarps of *Myxarium* nucleatum                                   | MN175326                       | –    | –    | –    | –    |
| **Bensingtonia**               |               |            |                           |                                                                        |                                |      |      |      |      |
| wuzhishanensis sp. nov.        | CGMCC 2.3569 = WZS33.18 = CBS 15661 | November 14, 2006 | Wuzhishan mountain, Hainan province, China | phylloplane                  | MK050366                       | –    | –    | –    | MK849054 |
| **B. pseudorectispora** sp. nov. | CGMCC 2.5677 = XZ154DS = CBS 15750 | September 21, 2014 | Bomi, Tibet, China | phylloplane                  | MK050367                       | MK849247 | MK849384 | MK849111 | MK848983 |
| **Pseudobensingtonia**         |               |            |                           |                                                                        |                                |      |      |      |      |
| fusiformis sp. nov.            | CGMCC 2.5823 = XZ152E3A = CBS 15647 | September 21, 2014 | Bomi, Tibet, China | phylloplane                  | MK050370                       | MK849123 | MK849265 | MK848997 | MK848870 |
| fusiformis sp. nov.            | CGMCC 2.5815 = XZ152E3 = CBS 15592 | September 21, 2014 | Bomi, Tibet, China | phylloplane                  | MK050368                       | MK849149 | MK849289 | MK849019 | MK848891 |
| **Boekhoutia**                 |               |            |                           |                                                                        |                                |      |      |      |      |
| sterigmata sp. nov.            | CGMCC 2.4539 = FJS3F22 = CBS 15553 | October 29, 2011 | Fanjingshan Mountain, Guizhou province, China | phylloplane                  | MK050371                       | MK849211 | –    | –    | MK849078 | MK848946 |
| **Ruinenia**                   |               |            |                           |                                                                        |                                |      |      |      |      |
| fanjingshanensis sp. nov.      | CGMCC 2.4542 = FJS6C7 = CBS 15745 | October 29, 2011 | Fanjingshan Mountain, Guizhou province, China | phylloplane                  | MK050372                       | MK849211 | MK849267 | MK849078 | MK848946 |
| **R. bangxiensis**             |               |            |                           |                                                                        |                                |      |      |      |      |
| sp. nov.                       | CGMCC 2.3454 = HBX1.0 = CBS 10819 ST-153 | November 24, 2006 | Bangxi county, Hainan province, China | phylloplane                  | MK050373                       | MK849167 | MK849305 | MK849035 | –    |
| **R. lunata**                  |               |            |                           |                                                                        |                                |      |      |      |      |
| sp. nov.                       | CGMCC 2.4426 = TW 2.1E-028 = CBS 12525 | August 17, 2009 | Taiwan, China | phylloplane                  | KP020113                       | –    | –    | MN014088 | MN014094 | MN014079 |
| TW 2.1E-05B                    |               |            |                           |                                                                        |                                |      |      |      |      |
| **Sterigmatospora**            |               |            |                           |                                                                        |                                |      |      |      |      |
| layuensis sp. nov.             | CGMCC 2.5817 = XZ100A2B = CBS 15649 | August 18, 2009 | Taiwan, China | phylloplane                  | KP020110                       | –    | –    | –    | MK849063 |
| **Pseudosterigmatospora**      |               |            |                           |                                                                        |                                |      |      |      |      |
| motuensis sp. nov.             | CGMCC 2.5816 = XZ119B3 = CBS 15591 | September 18, 2014 | Motuo, Tibet, China | leaf of Achyrospermum wallichianum                                    | MK050374                       | MK849253 | MK849389 | MK849115 | MK848888 |
| Species                          | Strain | Date            | Location                                      | Source          | 18S+ITS+D1/D2 | RPB1    | RPB2    | TEF1    | CYTB    |
|---------------------------------|--------|-----------------|-----------------------------------------------|-----------------|---------------|---------|---------|---------|---------|
| Phyllozyma jiayinensis sp. nov. | CGMCC 2.5669 = HLJ25.21 = CBS 13975 | August 25, 2014 | Qingshan county, Jiayin, Heilongjiang province, China | phylloplane     | MK050376     | –       | –       | MK849108 | MK848980 |
| P. aceris sp. nov.              | CGMCC 2.2662 = XZ17B1 = CBS 15773   | September 21, 2004 | Bomi county, Tibet, China                      | leaf of Acer caudatum | MK050377   | MK849136 | MK849276 | MK849006 | MK848879 |
|                                 | CGMCC 2.2617 = XZ14B2               | September 21, 2004 | Bomi county, Tibet, China                      | leaf of bamboo   | MK050378     | MK849132 | –       | MK849003 | –       |
| Meniscomicospora layuenensis sp. nov. | CGMCC 2.5818 = XZ100 = CBS 15747 | September 18, 2014 | Layue county, Tibet, China                     | phylloplane     | MK050379     | MK849248 | MK849385 | MK849112 | MK848984 |
|                                 | CGMCC 2.5681 = XZ100A2              | September 18, 2014 | Layue county, Tibet, China                     | phylloplane     | MK050380     | –       | –       | –       | –       |
| Sakaguchia melibiophila sp. nov. | CBS 5143 = JCM 8162 = CGMCC 2.4235 = IGC 5612 | n/a | The Netherlands                               | bronchial secretion | KJ778625/KJ708453/KJ708356 | KJ708079 | KJ708268 | KJ707858 | KJ707732 |
| Microsporomyces pseudomagnisporus sp. nov. | CGMCC 2.4538 = FJS25C3 = CBS 15746 | October 29, 2011 | Fanjingshan Mountain, Guizhou province, China | phylloplane     | MK050384     | MK849125 | MK849351 | MK849077 | –       |
| M. rubellus sp. nov.            | CGMCC 2.4444 = TW1.3F-017 = CBS 15622 | August 18, 2009 | Taiwan, China                                  | phylloplane     | MK050385     | MK849205 | MK849344 | MK849071 | –       |
|                                 | CGMCC 2.4445 = TW1.3F-026 = CBS 15256 | August 18, 2009 | Taiwan, China                                  | phylloplane     | MK050386     | MK849206 | MK849345 | MK849072 | MK848940 |
| M. ellipsoideus sp. nov.        | CGMCC 2.5664 = XZ137E4 = CBS 18020  | September 20, 2014 | Motuo county, Tibet, China                     | phylloplane     | MK050387     | MK849244 | MK849381 | MK849107 | MK848979 |
| Symmetrospora rhododendri sp. nov. | CGMCC 2.2613 = XZ49DX = CBS 15447 | September 21, 2004 | Luang county, Tibet, China                     | leaf of Rhododendron sp. | MK050388     | MK849130 | MK849271 | MK849001 | –       |
| Cystobasidium raffinophilum sp. nov. | CGMCC 2.3822 = 141.4 = CBS 15509   | July 6, 2007 | Yecheng county, Xinjiang province, China       | soil             | MK050389     | MK849191 | MK849329 | MK849058 | MK848927 |
| C. terricola sp. nov.           | CGMCC 2.3823 = 140.23 = CBS 15650  | July 6, 2007 | Yecheng county, Xinjiang province, China       | soil             | MK050390     | MK849192 | MK849330 | MK849059 | MK848928 |
|                                 | CGMCC 2.3824 = 141.8               | July 6, 2007 | Yecheng county, Xinjiang province, China       | soil             | MK050391     | MK849193 | MK849331 | –       | –       |
| Robertozyma ningxiaensis sp. nov. | CGMCC 2.4451 = HLS10.23 = CBS 12499 | August 21, 2009 | Helanshan mountain, Ningxia province, China    | soil             | MK050392     | –       | MK849348 | –       | MK84943 |
|                                 | CGMCC 2.4452 = HLS14.23            | August 21, 2009 | soil                                           | MK050393     | MK849209     | MK849349 | MK849075 | MK848944 | (continued on next page) |

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**Table 1. (Continued).**

| Species                          | Strain                      | Date                | Location             | Source                                      | 18S+ITS+D1/D2 | RPB1     | RPB2     | TEF1     | CYTB |
|----------------------------------|-----------------------------|---------------------|----------------------|---------------------------------------------|---------------|-----------|-----------|-----------|------|
| Begerowomyces foliicola sp. nov. | CGMCC 2.3164<sup>T</sup> = G7.4 = CBS 15655 | September 20, 2005  | Germany              | phyloplane                                  | MK050394      | MK849154  | MK849294  | MK849024  | MK848896 |
| Rosettozyma petaloides sp. nov.  | CGMCC 2.3446<sup>T</sup> = WZS29.14 = CBS 15480 | November 6, 2006    | Wuzhishan mountain, Hainan province, China | phyloplane                                  | MK050395      | MK849165  | MK849303  | MK849034  | MK848904 |
|                                  | CGMCC 2.3466 = WZS9.2 = CBS 15488 | November 16, 2006   | Wuzhishan mountain, Hainan province, China | phyloplane                                  | MK050396      | MK849174  | –         | –         | –     |
|                                  | CGMCC 2.3461 = WZS29.15     | November 6, 2006    | Wuzhishan mountain, Hainan province, China | phyloplane                                  | MK050397      | –         | –         | –         | –     |
| R. cystopteridis sp. nov.        | CGMCC 2.2615<sup>T</sup> = XZ16E1 = CBS 15448 | September 21, 2004  | Bomi county, Tibet, China | leaf of Cystopteris moupinensis | MK050398      | MK849131  | MK849272  | MK849002  | MK848876 |
|                                  | CGMCC 2.2619 = XZ5B2 = CBS 15451 | September 21, 2004  | Bomi county, Tibet, China | leaf of Rhododendron phaeochrysum | MK050399      | –         | –         | –         | –     |
| R. motuoensis sp. nov.           | CGMCC 2.5819<sup>T</sup> = XZ118E6 = CBS 15588 | September 19, 2014  | Motuo, Tibet, China | phyloplane                                  | MK050400      | MK849260  | MK849397  | –         | MK848991 |
| Rhodosporidiobolus platycladi sp. nov. | CGMCC 2.3118<sup>T</sup> = BJ6-3 = CBS 15469 | March 27, 2006      | Beijing, China | leaf of Platycladius sp. | MK050401      | MK849153  | MK849293  | MK849023  | MK848895 |
| R. jianfalingensis sp. nov.      | CGMCC 2.3532<sup>T</sup> = JF25.7-1 = CBS 15494 | May 10, 2007        | Jianfaling, Hainan province, China | phyloplane                                  | MK050402      | MK849179  | MK849317  | MK849048  | MK848917 |
|                                  | CGMCC 2.3531 = JF25.7-2     | May 10, 2007        | Jianfaling, Hainan province, China | phyloplane                                  | MK050403      | MK849178  | MK849316  | MK849047  | MK848916 |
| R. fuzhouensis sp. nov.          | CGMCC 2.4435<sup>T</sup> = FYJZ2-6 = CBS 12492 | August 18, 2011     | Fuzhou county, Fujian province, China | phyloplane                                  | MK050404      | MK849201  | MK849340  | MK849067  | MK848936 |
|                                  | CGMCC 2.4442 = TW4.3F1      | August 18, 2009     | Taiwan, China | phyloplane                                  | MK050405      | –         | –         | –         | –     |
|                                  | CGMCC 2.2286 = CBS 9205     | January 1, 2001     | Xishuang Banna, Yunnan province, China | leaf of Ficus sp. | KY105509/KY109744/MN180193 | MN180194 | MN180195 | MN180197 | MN180196 |
| Sporobolomyces cellubiolyticus sp. nov. | CGMCC 2.5675<sup>T</sup> = HLJ33B4 = CBS 13964 | August 26, 2014     | Wuyiling natural reserve, Heilongjiang province, China | phyloplane                                  | MK050406      | MK849246  | MK849383  | MK849110  | MK848982 |
|                                  | CGMCC 2.5687 = HLJ32B2 = CBS 13963 | August 25, 2014     | Chebu county, Heilongjiang province, China | phyloplane                                  | MK050407      | MK849249  | MK849386  | MK849113  | MK848985 |
| MCA 3774                         |                              | n/a                 | Alaska, Siberia and Newfoundland, Canada | phyloplane                                  | JN942193/JN940715 | –         | –         | –         | –     |
| Species                        | Strain                  | Date          | Location                              | Source         | 18S+ITS+D1/D2 | RPB1       | RPB2       | TEF1       | CYTB       |
|-------------------------------|-------------------------|---------------|---------------------------------------|----------------|---------------|-------------|-------------|-------------|-------------|
| *S. reniformis* sp. nov.      | CGMCC 2.5627 = GPS21.2C2 = CBS 15562 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | JN942199/JN940720 | –           | –           | –           | –           |
| *S. ellipsoideus* sp. nov.    | CGMCC 2.5619 = GPS21.5C1 = CBS 15590 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050409     | MK849225   | MK849364   | MK849088   | MK84957    |
|                               | CGMCC 2.5620 = GPS23.3A5 | September 22, 2015 | Lulang county, Tibet, China          | phylloplane    | MK050410     | –           | –           | –           | –           |
|                               | CGMCC 2.5621 = GPS20.1B3 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050411     | MK849227   | –           | MK849090   | MK84959    |
|                               | CGMCC 2.5622 = GPS20.1A4 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050412     | MK849228   | MK849366   | MK849091   | MK84960    |
|                               | CGMCC 2.5624 = GPS20.1H2 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050413     | –           | –           | MK849093   | MK84962    |
|                               | CGMCC 2.5625 = GPS22.1B3 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050414     | MK849229   | MK849368   | MK849094   | MK84963    |
|                               | CGMCC 2.5626 = GPS20.8C1 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050415     | –           | MK849369   | MK849095   | MK84964    |
|                               | CGMCC 2.5631 = GPS20.8C10 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050416     | MK849233   | –           | MK849099   | MK84969    |
| *Heitmania* sp.               | CGMCC 2.5602 = GPS20.16B3 = CBS 15549 | September 21, 2015 | Milin county, Tibet, China           | phylloplane    | MK050420     | MK849217   | MK849356   | MK849083   | MK84951    |
| *H. cylindrica* sp. nov.      | CGMCC 2.5650 = GPS20.2C8 = CBS 15568 | September 20, 2015 | Milin county, Tibet, China           | phylloplane    | MK050421     | MK849237   | MK849376   | MK849101   | MK84972    |
| *Heitmania* sp.               | CGMCC 2.3440 = SM35.2A  | November 10, 2006 | Simao county, Yunnan province, China | phylloplane    | MK050422     | MK849161   | MK849299   | MK849031   | MK84900    |
| *Heitmania* sp.               | CGMCC 2.3624 = SM35.2B  | November 10, 2006 | Simao county, Yunnan province, China | phylloplane    | MK050423     | MK849189   | MK849327   | MK849057   | MK84925    |
| *Microbotryozyma* swertiae sp. nov. | CGMCC 2.3533 = ZXS7.7 = CBS 15495 | May 10, 2007 | Chuxiong county, Yunnan province, China | leaf of *Swertia yunnanensis* | MK050424     | MK849180   | MK849318   | MK849049   | MK84918    |

(continued on next page)
| Species | Strain | Date      | Location                  | Source | 18S+ITS+D1/D2 | RPB1    | RPB2    | TEF1    | CYTB    |
|---------|--------|-----------|---------------------------|--------|--------------|---------|---------|---------|---------|
| Yamadamyces terricola sp. nov. | CGMCC 2.5820T = 03-1 = CBS 15572 | August 15, 2015 | Daxinganling, China soil | MK050425 MK849127 MK849268 MK848999 MK848874 |
| Oberwinklerzyma dicranopteridis sp. nov. | CGMCC 2.3441T = SM10.2 = CBS 15476 | November 6, 2006 | Simao county, Yunnan province, China leaf of Dicranopteris dichotoma | MK050426 MK849162 MK849300 – MK848901 |
| O. nepetae sp. nov. | CGMCC 2.5824T = XZ129C7 = CBS 15579 | September 20, 2014 | Motuo, Tibet, China leaf of Nepeta sp. | MK050427 MK849254 MK849391 – MK848992 |
| Chrysozyma pseudogriseo flava sp. nov. | CGMCC 2.5646 = GPS21.6B3 = CBS 15564 | September 21, 2015 | Milin county, Tibet, China phylloplane | MK050428 MK849232 MK849372 MK849098 MK848967 |
| | CGMCC 2.5646 = GPS21.6B3 = CBS 15564 | September 21, 2015 | Milin county, Tibet, China phylloplane | – – – – – |
| | CGMCC 2.5646 = GPS21.6B3 = CBS 15564 | September 21, 2015 | Milin county, Tibet, China phylloplane | – – – – – |
| C. sambuci sp. nov. | CGMCC 2.2618T = XZ13C5 = CBS 15450 | September 21, 2004 | Bomi county, Tibet, China leaf of Sambucus williamsii | MK050431 MK849133 MK849273 MK849004 – |
| | CGMCC 2.2755 = XZ13B7 | September 21, 2004 | Bomi county, Tibet, China leaf of Sambucus williamsii | MK050432 MK849137 MK849277 – – |
| C. rhododendri sp. nov. | CGMCC 2.5821T = XZ160D3 = CBS 15583 | September 21, 2014 | Tibet, China leaf of Rhododendron sp. | MK050433 MK849263 MK849400 MK849121 MK848995 |
| C. iridis sp. nov. | CGMCC 2.2769T = XZ8B3 = CBS 15461 | September 21, 2004 | Bomi county, Tibet, China leaf of Iris forestii | MK050434 MK849144 MK849285 MK849013 MK848886 |
| C. sorbariae sp. nov. | CGMCC 2.2768T = XZ9D1 = CBS 15460 | September 21, 2004 | Bomi county, Tibet, China leaf of Sorbaria arborea | MK050435 MK849143 MK849284 MK849012 MK848885 |
| | CGMCC 2.2767 = XZ11B4 | September 21, 2004 | Bomi county, Tibet, China leaf of Acer caudatum | MK050436 MK849142 MK849283 – MK848884 |
| C. fusiformis sp. nov. | CGMCC 2.2765T = XZ33C2 = CBS 15458 | September 21, 2004 | Lulang county, Tibet, China phylloplane | MK050437 MK849140 MK849281 MK849010 MK848883 |
| | CGMCC 2.2764 = XZ33Z1 | September 21, 2004 | Lulang county, Tibet, China phylloplane | MK050438 – – – – |
| C. cylindrica sp. nov. | CGMCC 2.3455T = WZS29.2 = CBS 15482 | November 6, 2006 | Wuzhishan mountain, Hainan province, China phylloplane | MK050439 MK849168 MK849306 MK849036 MK848906 |
| C. flav a sp. nov. | CGMCC 2.3455T = WZS29.2 = CBS 15482 | September 21, 2015 | Milin county, Tibet, China phylloplane | MK050440 MK849221 MK849360 MK849086 MK848955 |
| Species | Strain | Date | Location | Source | 18S+ITS+D1/D2 | RPB1 | RPB2 | TEF1 | CYTB |
|---------|--------|------|----------|--------|---------------|------|------|------|------|
| Yurkovia longicylindrica sp. nov. | CGMCC 2.5611^T = GPS20.4A1 = CBS 15552 | September 21, 2015 | Milin county, Tibet, China | phylloplane | MK050441 | MK849218 | MK849357 | MK849084 | MK848952 |
| Pseudohyphozyma lulangensis sp. nov. | CGMCC 2.5603^T = GPS20.2C3 = CBS 15550 | September 21, 2004 | Lulang county, Tibet, China | phylloplane | MK050442 | MK849129 | MK849270 | – | MK848875 |
| P. hydrangeae sp. nov. | CGMCC 2.2796^T = XZ46A1 = CBS 15462 | September 21, 2004 | Lulang county, Tibet, China | leaf of Hydrangea heteromalla | MK050443 | MK849126 | MK849287 | MK849015 | MK848888 |
| | CGMCC 2.2797 = XZ46C5 | September 21, 2004 | Lulang county, Tibet, China | leaf of Hydrangea heteromalla | MK050444 | MK849146 | MK849288 | MK849016 | – |
| | CGMCC 2.5607 = GPS20.2D2 | September 21, 2015 | Milin county, Tibet, China | phylloplane | MK050445 | MK849219 | MK849358 | – | MK848953 |
| | CGMCC 2.5618 = GPS23.3C2 | September 22, 2015 | Lulang county, Tibet, China | phylloplane | MK050446 | MK849224 | MK849363 | – | – |
| | CGMCC 2.5623 = GPS23.3D3 | September 22, 2015 | Lulang county, Tibet, China | phylloplane | MK050447 | – | MK849367 | MK849092 | MK848961 |
| | GPS23.3D2 | September 22, 2015 | Lulang county, Tibet, China | phylloplane | MK050448 | – | – | – | – |
| Sloofia globosa sp. nov. | CGMCC 2.5822^T = 4-6 = CBS 15573 | August 15, 2015 | Daxinganling, China | soil | MK050449 | MK849255 | MK849392 | MK849116 | MK848899 |
| Colacogloea aletridis sp. nov. | CGMCC 2.2766^T = XZ31A1 = CBS 15459 | April 4, 2005 | Bomi county, Tibet, China | leaf of Aletris pauciflora | MK050450 | MK849141 | MK849282 | MK849011 | – |
| C. hydrangeae sp. nov. | CGMCC 2.2798^T = XZ46B3 = CBS 15463 | April 11, 2005 | Lulang county, Tibet, China | leaf of Hydrangea heteromalla | MK050451 | MK849147 | – | MK849017 | MK848889 |
| C. rhododendri sp. nov. | CGMCC 2.2770^T = XZ10F1 = CBS 15652 | April 4, 2005 | Bomi county, Tibet, China | leaf of Rhododendron lulangense | MK050452 | MK849145 | MK849286 | MK849014 | MK848887 |
| | CGMCC 2.5651 = GPS20.5C1 | September 21, 2015 | Milin county, Tibet, China | phylloplane | MK050457 | MK849238 | – | MK849102 | MK848973 |
| | CGMCC 2.5652 = GPS20.5D6 | September 21, 2015 | Milin county, Tibet, China | phylloplane | MK050456 | MK849239 | – | MK849103 | MK848974 |
| | GPS20.5C5 | September 21, 2015 | phylloplane | MK050455 | – | – | – | – | – |
a case-by-case pairwise similarity approach was also provided here. We compared the sequence similarity and nucleotide variations in the ITS and D1/D2 regions among yeast genera containing more than two species in Agaricomycotina and Pucciniomycotina using the EMBOSS water alignment tool (http://www.ebi.ac.uk/Tools/psa/emboss_water/nucleotide.html; Madeira et al. 2019). The script, namely EMBOSS_water.py, was used to run the local alignment for the calculation of the sequence similarities and nucleotide variation including substitutions and deletions. All comparisons of sequence similarities were done with the type strains of the mentioned species in this study. It must be emphasised that diagnostic phenotypical features, especially physiological properties, were used to distinguish the new species from that previously described.

New generic and higher ranks circumscriptions

The circumscriptions of genera and higher ranks in the current study were performed mainly based on the multi-locus phylogenetic analyses used in previous studies (Wang et al. 2015a,b,c). The clustering optimisation analysis was done using the OPTSIL software (Göker et al. 2009) to yield non-hierarchical clusterings at generic levels by a given reference threshold, which had been employed in Liu et al. (2015b) and Wang et al. (2015b). The taxonomic thresholds predicted by Vu et al. (2016) to discriminate current yeast genera were 96.31 % for ITS and 97.11 % for D1/D2. Recently, the taxonomic thresholds predicted for filamentous fungal delimitation at the genus, family, order and class levels, recommended by Vu et al. (2019), were 94.3 %, 88.5 %, 81.2 % and 80.9 % for ITS, and 98.2 %, 96.2 %, 94.7 % and 92.7 % for D1/D2. The above taxonomic thresholds were considered, but not followed strictly, for circumscriptions of new genera and higher ranks in this study. Phenotypic differences were also discussed in the new generic circumscriptions.

RESULTS AND DISCUSSION

Diversity of phylloplane and soils yeasts

More than 1 000 plant leaves and 20 soil samples have been collected from 67 counties of 20 provinces in China (Tables 1 and 2, Fig. 1) during the past 20 years. About 1 440 strains isolated from those samples have been identified by ITS and D1/D2 sequences. Among them 180 strains belonging to Ustilagino- mycotina were not considered in this study. The other 1 260 strains belonging to Agaricomycotina and Pucciniomycotina were distributed in 58 genera, e.i. Ballistosporomyces, Bannoza, Bannozyma, Bensingtonia, Bucklezyma, Bullera, Bulleribasidium, Chrysozyma, Colacogloea, Cryptococcus, Cryptotrichosporon, Curvibasidium, Cutaneotrichosporon, Cystobasidiosis, Cystobasidium, Cystoflibasidium, Dermo- myces, Dioszegia, Erythrobasidium, Fellozyma, Fibulobasidium, Filobasidium, Genolevuria, Hannaella, Holtermannia, Holtermanniella, Itersonilia, Kockovaella, Kondoia, Kwonella, Leuco- sporidium, Microbotryum, Microsporomyces, Mirakia, Naganishia, Nachidea, Oberwinklerzyma, Papiliotrema, Phaeotremella, Phyllozyma, Piskurozyma, Pseudobensingtonia, Pseudophytozyma, Rhodosporydolobus, Rhodotorula, Ruinenia, Saitozyma, Sloaffia, Solicococozyma, Sporobolomyces,
### Table 2. List of known yeasts species in China.

| Taxa | Present in number of samples | Resources | Location* |
|------|-----------------------------|-----------|-----------|
| Tremellomycetes | | | |
| Tremellales | | | |
| Bulleraceae | | | |
| Bullera alba | 54 | Phylloplane | 1; 3; 5; 13; 14; 15; 17; 19; 20; 21; 25; 26; 27; 29; 33; 34; 38; 39; 40; 41; 42; 43; 49; 50; 54; 66* |
| B. pennisetica | 1 | Phylloplane | 52; |
| Genolevuria amylolytica | 2 | Phylloplane, 1 Soil, 1 | 2; 67; |
| G. tibetensisa | 7 | Phylloplane, 6 Soil, 1 | 2; 44; 42; 44; |
| Bulleribasidiacea | | | |
| Bulleribasidium foliicola | 10 | Phylloplane | 8; 12; 10; |
| B. hainanense | 2 | Phylloplane | 10; 12; |
| B. oberpochense | 3 | Phylloplane | 18; 44; |
| B. panicis | 3 | Phylloplane | 12; |
| B. pseudovariabilis | 14 | Phylloplane | 9;12; 24; 25; 32; |
| B. sanyaense | 3 | Phylloplane | 11; 10; |
| B. setariae | 3 | Phylloplane | 12; 36; 44; |
| B. variabilis | 31 | Phylloplane | 12; 25; 36; 44; 54; |
| B. wuzhishanense | 1 | Phylloplane | 12; |
| Derxomyces anomalus | 1 | Phylloplane | 40; 41; |
| D. boekhooutiis | 5 | Phylloplane | 4; 12; |
| D. boniennis | 6 | Phylloplane | 10; 12; 24; 32; |
| D. cuulongensis | 4 | Phylloplane | 44; |
| D. cylindricus | 3 | Phylloplane | 44; |
| D. hainanensis | 4 | Phylloplane | 12; |
| D. hubeiensis | 4 | Phylloplane | 12; 24; 36; |
| D. komagatae | 1 | Phylloplane | 25; |
| D. linziensis | 5 | Phylloplane | 41; 44; |
| D. mrakii | 55 | Phylloplane | 4;10;11;12; 24; 29; 31; 36; 54; 55; |
| D. nakasei | 10 | Phylloplane | 12; 24; 32; |
| D. pseudocylindrica | 4 | Phylloplane | 12; |
| D. pseudohuiaensis | 8 | Phylloplane | 24; 28; 31; |
| D. pseudoschimicola | 29 | Phylloplane | 4; 10; 12; 24; 32; 36; |
| D. qinlingensis | 2 | Phylloplane | 26; 30; |
| D. simaoensis | 1 | Phylloplane | 54; |
| D. waltii | 6 | Phylloplane | 12; 25; |
| D. wuzhishanensis | 3 | Phylloplane | 12; 44; |
| D. yunnanensis | 7 | Phylloplane | 36; 40;41; 44; 54; |
| Dioszegia athyriums | 1 | Phylloplane | 25; |
| D. aurantiaca | 50 | Phylloplane | 7; 12; 16; 24; 25; 27; 35; 38; 40; 41; 42; 44; 55; 67; |
| D. butyracea | 1 | Phylloplane | 27; |
| D. changbaensis | 4 | Phylloplane | 25; 54; |
| D. cream | 4 | Phylloplane | 25; 31; 45; |
| D. fistingensis | 6 | Phylloplane | 35; 37; 42; 45; |
| D. hungarica | 8 | Phylloplane | 3; 24; 25; 35; |
| D. statzelliae | 1 | Phylloplane | 31; |
| D. takashimae | 1 | Phylloplane | 8; |
| D. xingshanensis | 2 | Phylloplane | 32; |

(continued on next page)
| Taxa Present in number of samples | Resources   | Location* |
|----------------------------------|------------|-----------|
| D. zsoltii                       | 21         | Phyloplane | 1; 3; 4; 13; 24; 25; 31; 35; 51; 55; |
| Hannaella coprosmae              | 7          | Phyloplane | 25; |
| H. kunmingensis                  | 2          | Phyloplane | 50; |
| H. lutulenta                     | 18         | Phyloplane | 4; 8; 10; 12; 36; 44; 50; 51; 54; |
| H. oryzae                        | 20         | Phyloplane | 1; 4; 10; 11; 25; 36; 45; 52; 54; 55; |
| H. sinensis                      | 25         | Phyloplane | 3; 13; 8; 10; 11; 25; 31; 50; 51; 52; 54; |
| H. zeae                          | 1          | Phyloplane | 51; |
| H. phyllophila                   | 3          | Phyloplane | 67; |
| Vishniacozyra camescens          | 5          | Phyloplane, 3 Soil, 2 13; 26; 32; 35; 48; |
| V. dimenae                       | 1          | Phyloplane | 13; |
| V. globispora                    | 1          | Phyloplane | 27; |
| V. heimaeyensis                  | 1          | Soil       | 48; |
| V. tabaensis                     | 2          | Phyloplane | 8; 32; |
| V. tephrensis                    | 2          | Phyloplane | 13; 26 |
| V. victoriae                     | 13         | Phyloplane, 11 Soil, 2 2; 23; 24; 32; 42; 45; 48; 50; 52; 67; |
| Cryptococcaceae                  |            |            | |
| Kwoniella dendrophila            | 1          | Phyloplane | 13; |
| K. dejecticola                   | 1          | Phyloplane | 26; |
| Cuniculitremaceae               |            |            | |
| Kockovaella imperatae            | 1          | Phyloplane | 51; |
| K. mexicanus                     | 3          | Phyloplane | 9; 51; |
| K. sacchari                      | 2          | Phyloplane | 12; 51; |
| K. schimae                       | 1          | Phyloplane | 51; |
| K. sichuanensis                  | 1          | Phyloplane | 12; |
| Phaeotremellaceae               |            |            | |
| Papiliotrema aureus              | 1          | Phyloplane | 4; |
| P. flavescens                    | 3          | Phyloplane | 44; 52; 54; |
| P. fonsecae                      | 2          | Soil       | 48; |
| P. fuscus                        | 1          | Phyloplane | 44; |
| P. laurentii                     | 4          | Phyloplane, 1 Soil, 3 31; 48; |
| Phaeotremella skinneri           | 2          | Soil       | 2; |
| Sirobasidiaceae                 |            |            | |
| Fibulobasidium inconspicuum      | 2          | Soil       | 2; |
| F. munnhardtense                 | 1          | Soil       | 2; |
| Naemateliaceae                  |            |            | |
| Tremella indecorata              | 1          | Soil       | 2; |
| Trimorphomyctaceae              |            |            | |
| Saliozyma ninhiblinensis         | 1          | Phyloplane | 54; |
| S. podzolica                     | 5          | Phyloplane | 36; 54; |
| Trimorphomyces papilionaceus     | 2          | Phyloplane | 12; |
| Trichosporonales                |            |            | |
| Tetragonomycetaceae             |            |            | |
| Cryptotrichosporon anacardii     | 1          | Phyloplane | 67; |
| C. tibetense                     | 3          | Phyloplane | 38; |
| Takashimella formosensis         | 1          | Phyloplane | 44; |
| T. koraeensis                   | 1          | Phyloplane | 54; |
| Trichosporonales                |            |            | |
| Taxa | Present in number of samples | Resources | Location* |
|------|------------------------------|-----------|-----------|
| Cutaneotrichosporon arboriformis | 1 | Phylloplane | 36; |
| C. moniliiforme | 2 | Phylloplane, 1 Soil, 1 | 2; 40,41; |
| Holtermanniales | 2 | Phylloplane | 12; 54; |
| Holtermannia corniformis | 1 | Phylloplane | 2; |
| Holtermanniella festucosa | 2 | Phylloplane | 54; |
| H. nyarowii | 1 | Phylloplane | 44; |
| H. takashimae | 7 | Phylloplane, 6 Soil, 1 | 2; 67; |
| Filobasidiales | 7 | Phylloplane, 6 Soil, 1 | 2; 11; 22; 67; |
| Filobasidium chernovii | 1 | Phylloplane | 12; |
| F. elegans | 16 | Phylloplane, 8 Soil, 8 | 2; 13; 22; 26; 32; 36; 48; 52; 67; |
| F. magnum | 1 | Phylloplane | 45; |
| F. wieringae | 1 | Phylloplane | 52; |
| Naganishia adeliensis | 4 | Soil | 48; |
| N. albida | 10 | Phylloplane, 3 Soil, 7 | 26; 48; |
| N. albidosimilis | 1 | Soil | 48; |
| N. antarctica | 1 | Soil | 48; |
| N. diffuens | 2 | Phylloplane | 42; |
| N. liquefaciens | 1 | Phylloplane | 32; |
| N. uzbekistanensis | 3 | Phylloplane, Soil | 4; 48; |
| N. vishniacci | 1 | Soil | 48; |
| Piskurozymaceae | 2 | Phylloplane | 67; |
| P. flicatus | 1 | Soil | 2; |
| Solficocczyza terrei | 3 | Phylloplane, 1 Soil, 2 | 2; 44; |
| S. terricola | 1 | Soil | 2; |
| Cystofiobasidiales | 4 | Soil | 2; 26 |
| Cystofiobasidium capitatum | 11 | Phylloplane | 23; 24; 26; 38; 36; 37; 48; 53; 67; |
| I. perplexans | 10 | Phylloplane | 25; 23; 32; 38; 40; 41; 54; 55; |
| Mrakiaceae | 1 | Phylloplane | 67; |
| M. aquatica | 1 | Phylloplane | 2; |
| M. cryocentii | 1 | Soil | 42; |
| M. robusti | 1 | Soil | 2; |
| Tausonia pullulans | 1 | Soil | 2; |
| Udeniomyces kanasensis | 5 | Phylloplane | 45; 46; |
| U. pseudopyricularis | 26 | Phylloplane, 25 Soil, 1 | 2; 6; 25; 27; 32; 42; 48; 54; 55; 67; |
| U. puricus | 2 | Phylloplane | 27; 45; |
| U. pyricola | 9 | Phylloplane | 4; 23; 24; 31; 54; |
| Agaricostibomyctes | 2 | Phylloplane | 12; 38; |
| Agaricostibales | 2 | Phylloplane | (continued on next page) |

(continued on next page)
| Taxa | Present in number of samples | Resources | Location* |
|------|-----------------------------|-----------|-----------|
| Ballistosporomyces bomiensis | 2 | Phylloplane | 38; |
| B. changbaiensis | 2 | Phylloplane | 25; |
| B. taupoensis | 3 | Phylloplane | 25; |
| B. xanthus | 6 | Phylloplane | 25; |
| Cystobasidiopsis lactophilus | 1 | Phylloplane | 44; |
| C. lophatheri | 1 | Phylloplane | 37; |
| **Kondoaceae** | | | |
| Kondoa changbaiensis | 9 | Phylloplane | 25; 67; |
| K. phyllada | 2 | Phylloplane | 1; 44; |
| K. sorbi | 3 | Phylloplane | 25; |
| K. subrosea | 2 | Phylloplane | 45; |
| K. thailandica | 3 | Phylloplane | 36; 44; 38; |
| K. yuccicola | 3 | Phylloplane | 45; 67; |
| **Bensingtonia bomiensis** | 1 | Phylloplane | 38; |
| **K. naganoensis** | 6 | Phylloplane | 25; 55; |
| **B. pseudonaganoensis** | 21 | Phylloplane | 12; 24; 25; 32; 38; 67; |
| **B. rectispora** | 4 | Phylloplane | 41; |
| **Ruineniaceae** | | | |
| Ruinenia clavata | 1 | Phylloplane | 25; |
| R. diospyroris | 5 | Phylloplane | 36; |
| **Spiculogoeales** | | | |
| Phyllozyma linderae | 2 | Phylloplane | 25; |
| P. subbrunnea | 1 | Phylloplane | 25; |
| P. coprosmicola | 2 | Phylloplane | 25; 67; |
| P. dimmenae | 1 | Phylloplane | 25; |
| **Cystobasidiomycetes** | | | |
| **Cystobasidiales** | | | |
| Cystobasidium calyptogenae | 2 | Phylloplane | 44; |
| C. fimetarium | 1 | Soil | 48; |
| C. lysinophilum | 1 | Soil | 2; |
| C. minutum | 3 | Soil | 48; |
| C. slooffiae | 1 | Soil | 48; |
| C. pinicola | 1 | Phylloplane | 26; |
| **Erythrobasidiales** | | | |
| Bannoa hahajimensis | 4 | Phylloplane | 36; 44; |
| B. ogawarensis | 13 | Phylloplane | 4; 10; 12; 25; 36; |
| B. syzygi | 2 | Phylloplane | 25; 42; |
| Bannozyma arctica | 3 | Phylloplane | 32; |
| B. yamatoana | 19 | Phylloplane | 12; 23; 24; 25; 44; 54; 55; 67; |
| Erythrobasidium hasegawanum | 4 | Phylloplane | 25; |
| **Naohidaeales** | | | |
| Naohidea sebacea | 1 | Phylloplane | 16; 32; |
| **Buckeyzymaceae** | | | |
| Buckleyzyma aurantiaca | 1 | Soil | 2; |
| B. salicina | 1 | Phylloplane | 45; |
| **Symmetrosporaceae** | | | |
| Symmetrospora coprosmae | 9 | Phylloplane | 25; 27; 45; 50; 67; |
| Taxa                     | Present in number of samples | Resources             | Location* |
|-------------------------|------------------------------|-----------------------|-----------|
| S. oryzicola            | 6                            | Phylloplane           | 1; 25; 31; 32; |
| S. symmetrica           | 1                            | Phylloplane           | 1;        |
| Microsporomycetaceae    |                              |                       |           |
| Microsporomyces magnisorpus | 6                  | Phylloplane           | 36;       |
| Microbotryomycetes      |                              |                       |           |
| Microbotryum reticulatum | 1                         | Phylloplane           | 54;       |
| Sporidiobolales         |                              |                       |           |
| Rhodosporidium babjevae | 1                            | Phylloplane           | 57;       |
| Rhodosporidobolus colostri | 2                       | Phylloplane, Soil     | 2; 67;    |
| R. fluviale             | 2                            | Phylloplane           | 12; 67;   |
| R. lusitaniae           | 6                            | Phylloplane, Soil 2   | 4; 26; 36; 42; |
| R. microsporus          | 1                            | Phylloplane           | 10;       |
| R. nylandii             | 1                            | Phylloplane           | 10;       |
| R. odoratus             | 32                           | Phylloplane           | 1; 8; 10; 12; 25; 26; 31; 32; 38; 40; 41; 42; 44; 54; 66; 67; |
| R. poonscookiae         | 1                            | Phylloplane           | 51;       |
| R. ruineniae            | 3                            | Phylloplane           | 25; 36; 66 |
| Rhodotorula glutinis    | 1                            | Phylloplane           | 55;       |
| R. graminis             | 1                            | Phylloplane           | 44;       |
| R. kratochitlovae       | 1                            | Soil                  | 48;       |
| R. mucilaginosa         | 2                            | Phylloplane           | 26; 42;   |
| R. paludigena           | 1                            | Phylloplane           | 44;       |
| Sporobolomyces bannaensis | 1                        | Phylloplane           | 12;       |
| S. beijingensis         | 25                           | Phylloplane           | 1; 3; 18; 19; 22; 38; 56; 66 |
| S. bischofiae           | 1                            | Phylloplane           | 44;       |
| S. carnicolor           | 18                           | Phylloplane           | 4; 13; 8; 10; 11; 12; 36; 44; 54; |
| S. japonicus            | 3                            | Phylloplane           | 11; 12; 35; |
| S. jilinensis           | 20                           | Phylloplane           | 18; 19; 25; 56; 59; 60; 61; 63; 65 |
| S. phaffi               | 7                            | Phylloplane           | 3; 25; 24; 27; |
| S. roseus               | 31                           | Phylloplane, Soil 2   | 1; 25; 26; 27; 34; 45; 48; |
| S. ruberinus            | 10                           | Phylloplane           | 18; 19; 25; 56; 57; 58; 60 |
| S. salmonicolor         | 6                            | Phylloplane           | 18; 19; 57; 67; |
| S. shibatanus           | 11                           | Phylloplane           | 3; 8; 25; 36; 51; 56; 66; |
| Kriegeriales            |                              |                       |           |
| Yamadamyces rosulatus   | 1                            | Soil                  | 2; 67;    |
| Leucosporidiales        |                              |                       |           |
| Leucosporidium fellii   | 1                            | Phylloplane           | 67;       |
| L. scottii              | 1                            | Soil                  | 2; 67;    |
| Colacogloeaceae         |                              |                       |           |
| Colacogloeaa diffluens  | 1                            | Phylloplane           | 54;       |
| C. falcata              | 3                            | Phylloplane           | 40; 41; 67; |
| C. foliorum             | 1                            | Phylloplane           | 67;       |
| Chrysosyzaceae          |                              |                       |           |
| Chrysosyzma griseoflava | 20                           | Phylloplane           | 12; 24; 25; 31; 44; 54; 67; |
| Felluzyma inositophilia | 4                            | Phylloplane           | 35; 32; 55; 67; |
| incertae sedis          |                              |                       |           |
| Curvibasidium cygneicollum | 8                        | Phylloplane           | 25; 26; 38; 55; |

(continued on next page)
Among known species, 170 species belonging to 52 genera were isolated from surfaces of plant leaves commonly referred to as phylloplane (Fonseca & Inácio 2006, Morais et al. 2006, Nakase et al. 2006, Kemler et al. 2017, Limtong & Nasanit 2017). A total of 42 species belonging to 24 genera were isolated from soils (Table 2). The difference of species diversity between soils and leaves was not analysed in this study because soils and plants were not always collected simultaneously. Most species isolated from soils were previously reported among species occurring in soils by Botha (2006, 2011), Yurkov et al. (2016), Yurkov (2017) and Groenewald et al. (2018), such as Vishniacozyma victoriae, Naganishia adeliensis, Tausonia pullulans, Holtermanniella wattiica, Cystobasidi um minutum and Cutaenoebrichosporon moniliiforme (Table 2). Among species isolated from soils in China, a few have been reported from habitats other than soils, for example, Fibulobasidi um inconspicuum from leaves in a river (Sampaio et al. 2002), Genelevuria tibetensis from leaves (Wang et al. 2007) and Yamadamyces rosulatus from dead pine needle (Golubev & Scorzetti 2010).

Among the 101 undescribed species, some are represented by one or only a few isolates. It is difficult to determine if these are rare species or simply undersampled. We continuously collected samples from different locations in China over the past 20 years and some places were revisited many times, such as Milin, Lulang and Bomi counties in Tibet (Table 1). However, a number of single strain species isolated in 2004 were never isolated again despite resampling from the same locations in 2014 and 2015 (Table 1). Phenotypic for these seemingly rare species (Table S1) indicated that most of them grow at low temperature, which may result in slow-growing and competitive disadvantage to other dominant species in a microbial community. In contrast, some known species are frequently isolated from the same or different locations in China, such as Bullera alba isolated from 26 counties, Dioszegia aurantiaca from 14 locations and Rhodospordinobolus orodatus from 16 locations (Table 2); these commonly isolated species all grow well at room temperature.

Species-by-species pairwise similarity comparison in basidiomycetous yeast genera

Over the past decades, the number of yeast species has increased from 700 (Kurtzman & Fell 1998) to 2,000 (Vu et al. 2016), which benefits from the application of DNA sequence analysis for identification of yeast species (Kurtzman et al. 2015). Relying on results from mating experiments and pairwise DNA-DNA hybridisation values for several ascomycetous genera and species, Kurtzman & Robnett (1998) suggested that different species are likely to show greater than 1% substitutions in nucleotide sequences of the D1/D2 domains in pairwise comparisons and strains with less than three nucleotides differences are likely to either be conspecific or sister species. Fell et al. (2000) observed that when a sufficient number of strains has been studied, different species of basidiomycetous yeasts differed in two or more nucleotides in the D1/D2 domains. In the same time, the authors pointed to several conflicts between taxonomic assignments and pairwise sequence comparisons. Specifically, strains of different species in both Agaricomycotina and Pucciniomycotina sometimes shared identical D1/D2 sequences but showed distinct sequences of the ITS region (Fell et al. 2000). The follow-up study performed by Scorzetti et al. (2002) did not find a common similarity threshold for basidiomycetous yeasts in both D1/D2 and ITS regions and suggested that both gene regions are necessary for a reliable species delimitation. Importantly, sequence variability patterns in these two gene regions depend on a phylogenetic lineage. While ITS is often more...
variable than D1/D2 domains of the LSU, the situation was opposite in Trichosporonales and among the members of the Aerius clade of Filobasidiales (Scorzetti et al. 2002). Sequence heterogeneity among sexually compatible strains of teleomorphic species exceeded 1 % in a few genera. Despite distant evolutionary relationships between ascomycetous and basidiomycetous yeasts, the “1 % threshold” was used as an argument to delimit species in the latter group. Even in ascomycetes, this cutoff value is not uniformly applied to all genera (e.g. Clavispora, Metschnikowia, Ogataea). Nevertheless, this threshold was repeatedly used in the taxonomic literature (e.g. Kurtzman & Fell 2006, Kurtzman 2014, 2015, Kurtzman et al. 2015). Results of studies performed by Kurtzman & Robnett (1998), Fell et al. (2000) and Scorzetti et al. (2002) were recently revised by Vu et al. (2016). The authors observed similar taxonomic threshold, 98.41 % (or 99.21 % using ex-type strains only) for ITS and 99.51 % for LSU, considering all species recognised as yeasts.

The above two threshold values have been calculated for all yeast species and strains. A case-by-case sequences similarity analysis for each genus should be more helpful than those general values to delimit species. In the present work, the sequence similarities and nucleotide variation in the ITS region and D1/D2 domains among all yeast genera that contain more than two species were determined from local alignments for 40 genera of Agaricomycotina and 30 genera of Pucciniomycotina (Table 3 and Tables S2.1–S2.70). In agreement with previous observation, sequence variability in the ITS region was, in general, greater than in D1/D2 domains for most, but not all, studied yeast genera (Table 3). All species in Holtermanniella displayed larger variability in the D1/D2 domains (11–20 nt difference) than in the ITS region (3–7 nt difference). Sequence heterogeneity among species in the following four genera, Solicooccyma and Naganishia in the Filobasidiales, Trichosporon and Apiotrichum in Trichosporonales, did not show a stable pattern. For example, type strain of Solicooccyma terrea differed from Solicooccyma fuscescens by 10 nt in D1/D2 domains, and three nt in ITS region, whereas the latter species differed from Solicooccyma aerie at eight D1/D2 positions and 13 ITS positions. Naganishia liquefaciens and Naganishia altid similis had identical ITS sequences but showed eight D1/D2 nucleotide differences, whereas Naganishia onofrii and Naganishia vaughanmartiniae had identical D1/D2 sequences and 17 mismatches in ITS region. Apiotrichum laibachii and Apiotrichum multisporum shared identical ITS sequences and seven differences in the D1/D2 domains. In the same time sequences of Apiotrichum scarabaeorum and Apiotrichum terrigenum differed by five and 16 nucleotides in the D1/D2 domains and ITS region, respectively. Similarly, Trichosporon asahii differed from Trichosporon coremiiforme by two nucleotides in ITS region and eight nucleotide positions in D1/D2 domains, whereas the latter species differed from Trichosporon dohaense by only one nucleotide substitution in the D1/D2 domains and nine positions in ITS.

Our pairwise similarity comparison results indicated that a few well recognised species have less than 1 % nucleotide variation in both ITS region and D1/D2 domains, which in agreement with results by Scorzetti et al. (2002). However, these species can be separated by other taxonomic characters and multi-locus sequences analyses (MLS). For example, Rhodotorula glutinis and Rhodotorula graminis (D1/D2: 1, ITS: 2 Table S2.67) were...
### Table 3. Number of nucleotide variation and sequence similarities in the D1/D2 domain and ITS region among the type strains of species in the 70 genera.

| Lineage/Genus                | D1/D2 | ITS          |
|-----------------------------|-------|--------------|
| Anamorphycomata             |       |              |
| Tremellomyces               |       |              |
| Trichosporonales            |       |              |
| Apicotrichum                | 2-66  | (99.7-89.5 %) |
| Cryptótrichosporon          | 8-29  | (98.5-95.7 %) |
| Cutanéotrichosporon         | 2-43  | (99.7-93.1 %) |
| Takashimella                | 1-16  | (99.8-96.9 %) |
| Trichosporon                | 1-49  | (99.6-92.2 %) |
| Vaninia                     | 11-123(97.5-77.6 %) | 11-122(97.7-76.4 %) |
| Holtermanniales             |       |              |
| Holtermannia                | 11-20 | (98.3-96.7 %) |
| Cystofibosidiales           |       |              |
| Cystofibosidium             | 10-54 | (98.3-90.7 %) |
| Mrika                       | 1-19  | (99.8-97.0 %) |
| Itersonilia                 | 7-30  | (98.8-94.9 %) |
| Krasnîkovozyza              | 2-13  | (99.6-97.5 %) |
| Tausonia                    | 17-29 | (97.3-95.3 %) |
| Udeniomyces                 | 4-11  | (99.4-98.3 %) |
| Filobasidiales              |       |              |
| Filobasidiun                | 0-21  | (100.0-96.7 %) |
| Goffeauxzyma                | 3-51  | (99.5-90.8 %) |
| Heterocephalacria           | 5-131 | (99.1-77.1 %) |
| Naganishia                  | 0-47  | (100.0-92.4 %) |
| Pläkurzyza                  | 7-71  | (98.8-88.3 %) |
| Sollococcusozyza            | 3-48  | (99.5-92.3 %) |
| Tremellales                 |       |              |
| Bullera                     | 8-45  | (98.7-92.9 %) |
| Bullenbasidium              | 1-91  | (99.8-84.2 %) |
| Canirincomyces              | 42-72 | (91.8-96.6 %) |
| Carlotrorosae               | 14-16 | (97.4-97.1 %) |
| Cryptococcus                | 0-31  | (100.0-94.8 %) |
| Denromyes                   | 3-42  | (99.5-93.5 %) |
| Dioszegia                   | 3-29  | (99.5-95.1 %) |
| Fellomyces                  | 4-39  | (99.4-93.8 %) |
| Fibulobasidium              | 2-6   | (99.6-98.9 %) |
| Genoleuvia                  | 7-17  | (98.6-97.6 %) |
| Hannaeilla                  | 6-59  | (99.0-89.6 %) |
| Kockovaëlla                 | 2-39  | (99.7-93.8 %) |
| Kwoniella                   | 0-42  | (100.0-93.3 %) |
| Naematelia                  | 1-13  | (99.8-97.9 %) |
| Papilotrema                 | 2-51  | (99.6-91.7 %) |
| Pheötemrella                | 1-28  | (99.8-95.3 %) |
| Pseudotremella              | 34-51 | (94.4-91.9 %) |
| Rhynchogastrema             | 1-19  | (99.8-90.7 %) |
| Saitzoyza                   | 18-64 | (97.0-89.4 %) |
| Tremella                    | 6-104 | (99.0-88.6 %) |
| Vishnizajzyma               | 7-64  | (98.8-90.1 %) |

### Table 3. (Continued).

| Lineage/Genus            | D1/D2 | ITS          |
|--------------------------|-------|--------------|
| Agaricostilbomycetes     |       |              |
| Ballistosporomycetes     | 2-34  | (99.7%-97.2 %) |
| Bensiangtonia            | 8-52  | (98.7-91.8 %) |
| Cystostasisopiosis       | 17-24 | (97.2-96.1 %) |
| Kondoa                   | 2-90  | (99.7-83.8 %) |
| Kurtzmanomyces           | 10-61 | (98.4-90.4 %) |
| Ruinenia                 | 13-76 | (97.8-88.3 %) |
| Sterigmatomyces          | 12-33 | (97.9-94.7 %) |
| Spathulogloeomycetes     |       |              |
| Phyllozyma               | 3-91  | (99.5-85.7 %) |
| Cystobasidiomycetes      |       |              |
| Bannoa                   | 11-21 | (98.3-96.8 %) |
| Buckleyzyma              | 4-21  | (99.4-96.7 %) |
| Cystobasidium            | 3-44  | (99.5-92.1 %) |
| Erythrobasidium          | 8-24  | (98.7-96.0 %) |
| Microsporomycetes        | 29-70 | (94.3-86.1 %) |
| Occultifur               | 6-16  | (90.0-97.3 %) |
| Sokaguchia               | 7-68  | (98.7-87.7 %) |
| Symmetspora              | 2-34  | (99.7-94.6 %) |
| Microbotryomycetes       |       |              |
| Colacoolea               | 14-61 | (97.7-90.2 %) |
| Curvibasidium            | 3-7   | (99.5-98.9 %) |
| Glaciozyma               | 7-20  | (98.6-96.4 %) |
| Hamamatoiza              | 1-8   | (99.8-98.7 %) |
| Heltmania                | 2     | (97.7 %) |
| Leucosporidium           | 1-27  | (99.8-95.3 %) |
| Oberwinklerzyma          | 3-10  | (99.4-98.1 %) |
| Phenolifera              | 5-14  | (99.7-97.5 %) |
| Pseudophyphozyma         | 3-8   | (99.5-98.6 %) |
| Rhodosporidobolus        | 4-41  | (99.2-93.1 %) |
| Rhodotorula              | 0-45  | (100.0-92.6 %) |
| Sloflofa                 | 7-49  | (98.9-92.1 %) |
| Spencerzyma              | 4-42  | (99.3-93.0 %) |
| Sporobolomyces           | 5-49  | (100.0-91.9 %) |

distinguished by physiological properties (Sampaio 2011a) and on the basis of DNA-DNA hybridisation experiments (Kurtzman & Fell 1991). Recently, a MLS approach combining with the analysis of genes comprising mating locus was used to delimit species in the *Papiliotrema favescens/Papiliotrema terrestis* species complex (Yurkov et al. 2015a), *Cryptococcus gattii* *Cryptococcus neoformans* species complex (Hagen et al. 2015) and *Cryptococcus amyloïdites* species complex (Passer et al. 2019), all of which showed less than 1 % ITS and D1/D2 sequences divergence (Tables S2.24 and S2.34). Thus, it is important to keep in mind that delimitation of closely related species which have less than 1 % sequence heterogeneity in both D1/D2 and ITS regions requires additional analyses and more robust data such as detailed physiological characterisation, mating experiments, multi-locus analyses and even whole-genome comparisons. Delimitation of closely related species in
genera with a few known species is, thus, extremely difficult in spite of the lack of data for analyses.

New taxa delineation and phylogenetic placement

The sequences of the D1/D2 and ITS regions for the 199 strains (Table 1) including 11 isolates from Germany deposited in the China General Microbiological Culture Collection Center (CGMCC) and 16 strains from Japan, Thailand, Portugal, Italy, USA, DSMZ and CBS collections employed in this study were determined. The SSU region of 138 strains representing at least one strain of each potentially new species were sequenced. A total of 142 RPB1, 137 RPB2, 126 TEF1 and 126 CYTB new sequences were generated (Table 1). The D1/D2 and ITS sequences for each strain were blasted against the GenBank database using the BLASTn tool to search for their closely related described species. Sequences of their close relatives and other phylogenetic important taxa were retrieved from GenBank (Table S3). In order to show the phylogenetic positions of these undescribed strains, multi-loci phylogenetic trees were constructed from two datasets, the combined 5.8S, D1/D2 and SSU dataset and the combined 5.8S, D1/D2, SSU, RPB1, RPB2, TEF1 and CYTB dataset. The phylogenetic trees (Figs 2, 4 and S1, S2) drawn from the seven-genes and three rDNA datasets were used to determine the phylogenetic positions for each new species. The trees (Figs 3, 5) constructed from the D1/D2 dataset were used to calculate the similarity between the new species and their closely related described species as the D1/D2 sequences are available for all known species employed here, which is not the case for the ITS and SSU sequences.

One hundred and seven new species were delimited from the 199 strains using the species identification benchmarks suggested by Fell et al. (2000), Scorza et al. (2002), Kurtzman & Fell (2006), Kurtzman (2014, 2015) and Kurtzman et al. (2015) as well as the taxonomic thresholds of yeast species recommended by Vu et al. (2016) and phenotypical features (Kurtzman et al. 2011). Forty-three new species occur in 15 genera in the Tremellomycetes (Agaricomycotina) and 52 new species distribute in 20 genera in the Pucciniomycotina (Figs 2–6 and S1–S6, Table 1). However, none of these known genera appears as an obvious candidate to accommodate the other 12 new species. Therefore, eight new genera, named as Boekhoutia, Robertozyma, Rosettozyma, Siagistomatospora, Robertozyma, Rosettozyma, Sterigmatospora and Teunia, are proposed to accommodate these 12 species.

The novel genus Teunia, located in the Cryptococcaceae (Tremellales, Tremellomycetes, Agaricomycotina), was clustered with the genera Cryptococcus and Kwoniella with 96–100 % bootstrap and 1.0 posterior probability supports in seven-genes and rDNA phylogeny (Figs 2A and S1A). However, these three genera can be separated by the clustering optimisation analysis (Table S4). Three species, namely Cryptococcus curiculi, Fonsecayama tronadorensis and Fonsecayama betulae, were classified in this new genus (Figs 2C, 3G and S1C). The phylogenetic position and composition of this clade have been changing during the last decade. The oldest known species Cr. curiculi has affinity with the erroneously identified as Cryptococcus heveanensis strain CBS 8976 in the Kwoniella clade that was described by Shin et al. (2006). Later, Boekhout et al. (2011), de Garcia et al. (2012) and Weiss et al. (2014) also indicated that Cr. curiculi belonged to the Kwoniella clade. de Garcia et al. (2012) described another species Cryptococcus tronadorensis in this clade resolved in a LSU-based phylogenetic analysis. However, a constrained with the seven-genes topology LSU phylogenetic analysis performed by Liu et al. (2015b) showed that Cr. curiculi was placed in the Tremella clade (Millanes et al. 2011) and not close to the Kwoniella clade, so that this species left unclassified as Cr. curiculi pro tem. It is important to document that the phylogenetic analysis was inconsistent with the previous results obtained by Shin et al. (2006), Boekhout et al. (2011), de Garcia et al. (2012) and Weiss et al. (2014) indicating that Cr. curiculi was most likely a member of Cryptococcaceae. Furthermore, the two closely related species Cr. curiculi and Cr. tronadorensis were placed in two different clades (Liu et al. 2015b). The latter species was clustered with a good support with Cryptococcus mujiesensis and Kwoniella betulae. It is important to note that K. betulae was described as a species of the genus Kwoniella based on its close phylogenetic relatedness to the erroneously identified as Cr. heveanensis strain CBS 8976. Because K. betulae was not related to other species of Kwoniella and Cr. mujiesensis and Cr. tronadorensis were distantly related to the genus Cryptococcus, a new genus Fonsecayama was proposed to accommodate Fo. mujiesensis, the type species of Fonsecayama, Fo. tronadorensis and Fo. betulae (Liu et al. 2015b). The type species of Fonsecayama was included in the seven-genes phylogeny as a single-species lineage closely related to Sirobasidium intermedium (Liu et al. 2015a) which was also in agreement with the original paper (Shin et al. 2006). This was one of a few important conflicts between constrained LSU and seven-genes analyses. The decision to propose a new genus for this clade was supported by the results of the constrained LSU analysis which also demonstrated that the Fonsecayama clade contained three potential new species isolated but not described in earlier studies performed by Inácio (2003). It was important to name this clade so that provisionally named as “Cryptococcus” new species would be properly placed and not mistaken with either Kwoniella or Cryptococcus (Liu et al. 2015b).

The phylogenetic analyses of the three datasets in this study also supported that Fo. mujiesensis has affinity with Si. intermedium instead of the Kwoniella clade (Figs 2A, 3A and S1A). Fo. tronadorensis was originally described as Cr. tronadorensis and related to the Kwoniella clade (de Garcia et al. 2012). Fo. betulae was originally described as K. betulae (Sylvester et al. 2015). The analyses in this study showed that Fo. tronadorensis, Fo. betulae, Cr. curiculi and three newly described species formed a well supported clade closely related to Cryptococcus and Kwoniella, but still separated from them (Figs 2C, 3G and S1C), which is in agreement with the results of de Garcia et al. (2012) and Sylvester et al. (2015). The question is why Fo. tronadorensis and Fo. betulae clustered with Fo. mujiesensis instead of Cr. curiculi in the D1/D2 tree from Liu et al. (2015b). After double-checking the D1/D2 alignment used in Liu et al. (2015b), we found out that the D1/D2 sequences of Fo. mujiesensis and Cr. curiculi were swapped with each other. We also checked the placement of other species in the D1/D2 tree from Liu et al. (2015b). We have not found other mistakes in that tree, which indicated that the D1/D2 dataset is reliable except for the sequence swap between Fo. mujiesensis and Cr. curiculi. Therefore, Fo. tronadorensis, Fo. betulae and Cr. curiculi were combined or validated in the new genus Teunia in this study (see Taxonomy section).
Fig. 2. Phylogenetic tree inferred using the combined sequences of RPB1, RPB2, TEF1, CYTB, SSU rDNA, LSU rDNA D1/D2 domains and 5.8S rDNA, depicting the phylogenetic positions of new taxa (in bold) within Tremellomyces (Agaricomycotina). The tree backbone was constructed using maximum likelihood analysis. Bootstrap percentages of maximum likelihood analysis over 50% from 1000 bootstrap replicates and posterior probabilities of Bayesian inference above 0.9 are shown respectively from left to right on the deep and major branches. Bar = 0.05 substitutions per nucleotide position. Note: ns, not supported (BP < 50% or PP < 0.9); nm, not monophyletic. The new taxa are in bold.
Saitozyma pseudoflava sp. nov. CGMCC2.5811T
Carlosrosaea foliicola sp. nov. CGMCC2.3447T
Carlosrosaea simaoensis sp. nov. CGMCC2.3580T
Kockovaella/Fellomyces
Sterigmatosporidium polymorphum
Carcinomyces arundinariae
Fibulobasidium inconspicuum
Sirobasidium magnum
Rhynchogastrema
Papiliotrema
Fonseczyma mujuensis
Sirobasidium intermedium
Pseudotremella
Bullera
Genolevuria
Dimennazyma cistialbidi
'Tremella indecorata' CBS6976
Tremella aurantia
Trimorphomyces sakaeratica
Trimorphomyces papilionaceus
Saitozyma pseuodoflava sp. nov. CGMCC2.5811T
Carlosrosaea simaoensis sp. nov. CGMCC2.3580T

Dioszegia milinica sp. nov. CGMCC2.5628T
Dioszegia heilongjiangensis sp. nov. CGMCC2.5674T
Dioszegia kandeliae sp. nov. CGMCC2.5658T
Dioszegia ovata sp. nov. CGMCC2.3625T
Dioszegia maotaiensis sp. nov. CGMCC2.4537T
Dioszegia milinica sp. nov. CGMCC2.5628T
Dioszegia aurantiaca
Dioszegia xinghanensis
Dioszegia crocea
Dioszegia cryoxerica
Dioszegia changbaensis
Dioszegia heilongjiangensis sp. nov. CGMCC2.5674T
Dioszegia antarctica
Dioszegia fristingensis
Dioszegia butyracea
Dioszegia hungarica
Dioszegia buhagiarii
Dioszegia kandelae sp. nov. CGMCC2.5658T
Dioszegia ovata sp. nov. CGMCC2.3625T
Dioszegia catarinonii
Dioszegia athyri
Dioszegia maotaiensis sp. nov. CGMCC2.4537T
Nielozyma formosana
Nielozyma melastomae
Vishniaczyma
Hannaella
Bulleribasidium
Kwoniella dendrophiila
Kwoniella ovata sp. nov. CGMCC2.3439T
Kwoniella pini
Kwoniella dejecticola
Kwoniella bestiolar
Kwoniella mangroviensis
Kwoniella heveanensis
Kwoniella shandongensis
Cryptococcus neoformans
Cryptococcus depauwensis
Cryptococcus amyloleatus
Teunia korlaensis sp. nov. CGMCC2.3835T
Teunia helanensis sp. nov. CGMCC2.4450T
Teunia globosa sp. nov. CGMCC2.5648T
Teunia cuniculi comb. nov.
Fig. 2. (Continued).
Fig. 2. (Continued).
Fig. 3. Phylogeny of new yeast species in the Tremellomycetes (Agaricomycotina) inferred from the sequences of the LSU rDNA D1/D2 domains by maximum likelihood analysis and over 50 % from 1 000 bootstrap replicates is shown. Tree topology was backbone-constrained with the well-supported (>80 %) bipartitions of the topology of the seven-genes tree. Bar = 0.1 substitutions per nucleotide position.
Fig. 3. (Continued).
Kockovaella/Fellomyces/Cuniculatrema/Carcinomyces
Rhynchogastrema/Papiliotrema/Pseudotremella
Bullera/Tremella clade I/Tremella clade II
Tremella celata/Tremella haematommatis

Dioszegia milina sp. nov. CGMCC2.5628T
Dioszegia milina sp. nov. CGMCC2.5674T

Dioszegia heilongjiangensis sp. nov. CGMCC2.5662
Dioszegia xinghanensis
Dioszegia patagonica

Dioszegia ovata sp. nov.

Dioszegia milina sp. nov.

Fig. 3. (Continued).
Fig. 3. (Continued).
**List of Fungi**

- **Tremella globispora**
- **Tremella dysenterica**
- **Tremella sp. JN043572**
- **Tremella samoensis**
- **Tremella sp. MH712816**
- **Tremella erythraeus**
- **Tremella saccharicola**
- **Tremella sp. LC177016**
- **Tremella sp. MG250358**
- **Tremella cinnabarina**
- **Tremella flava**
- **Tremella yokohamensis**
- **Tremella basidiomaticola**
- **Tremella fuciformis**
- **Tremella resupinata**
- **Tremella sp. MH712815**
- **Tremella taiwanensis**
- **Tremella sp. MH712787**
- **Tremella cerebriformis**
- **Tremella brasiliensis**
- **Tremella mesenterica**
- **Tremella tropica**

**Vishniacozyma**

- **Vishniacozyma globispora**
- **Vishniacozyma dimennae**
- **Vishniacozyma ellesmerensis**
- **Vishniacozyma kurtzmanii**

**Kwoniella**

- **Kwoniella sp. MG190048**

**Teunia**

- **Cryptococcus**

Fig. 3. (Continued).
Fig. 3. (Continued).
Holtermannia saccardoi sp. nov.

Fig. 3. (Continued).
DIVERSITY AND PHYLOGENY OF BASIDIOMYCETOUS YEASTS

Fig. 3. (Continued).
Fig. 4. Phylogenetic tree inferred using the combined sequences of RPB1, RPB2, TEF1, CYTB, SSU rDNA, LSU rDNA D1/D2 domains and 5.8S rDNA, depicting the phylogenetic positions of new taxa (in bold) within Pucciniomycotina. The tree backbone was constructed using maximum likelihood analysis. Bootstrap percentages of maximum likelihood analysis over 50 % from 1 000 bootstrap replicates and posterior probabilities of Bayesian inference above 0.9 are shown respectively from left to right on the deep and major branches. Bar = 0.2 substitutions per nucleotide position. Note: ns, not supported (BP < 50 % or PP < 0.9); nm, not monophyletic. The new taxa are in bold.
DIVERSITY AND PHYLOGENY OF BASIDIOMYCETOUS YEASTS

Fig. 4. (Continued).
Fig. 4. (Continued).
Fig. 5. Phylogeny of new yeast species in the Pucciniomycotina inferred from the sequences of the LSU rDNA D1/D2 domains by maximum likelihood analysis and over 50% from 1 000 bootstrap replicates is shown. Tree topology was backbone-constrained with the well-supported (>80%) bipartitions of the topology of the seven-genes tree. Bar = 0.1 substitutions per nucleotide position.
Fig. 5. (Continued).
Fig. 5. (Continued).
Sporidiobolus sp. KY109710
Sporobolomyces metaroseus
Sporobolomyces sp. EU002845
Sporidiobolus sp. AY015271
Sporobolomyces reniformis sp. nov. CGMCC2.5627T
CGMCC2.5675T
CGMCC2.5687
MCA3774 JN940715
MCA3785 JN940720
Sporobolomyces roseus
Sporobolomyces jilinensis
Sporobolomyces salmoneus
Sporobolomyces marcillae
Sporobolomyces patagonicus
Sporobolomyces primogenomicus sp. nov. JCM 8242T
Sporobolomyces ruberrimus
Sporobolomyces shibatanus JCM5350
Sporobolomyces shibatanus CBS484
Sporobolomyces phaffii
Sporobolomyces carnicolor
Sporobolomyces koalae
Sporobolomyces blumeae
Sporobolomyces japonicus
Sporobolomyces longiusculus
Sporobolomyces bannaensis
Sporobolomyces beijingensis
Sporobolomyces salmonicolor
Sporobolomyces johnsonii
Rhodotorula graminis
Rhodotorula glutinis
Rhodotorula diobovata
Rhodotorula babjevae
Rhodotorula evergladiensis
Rhodotorula araucariae
Rhodotorula kratochvilovae
Rhodotorula paludigena
Rhodotorula toruloides
Rhodotorula mucilaginosa
Rhodotorula albormescens
Rhodotorula dairenensis
Rhodotorula pacifica
Rhodotorula taiwanensis
Rhodotorula sphaeroarpa
CMCC 2.2286
Rhodosporidiobolus fuzhouensis sp. nov.
CGMCC2.4442
CGMCC2.4435T
Rhodosporidiobolus colostri
Rhodosporidiobolus oreadorum
Rhodosporidiobolus lusitaniae
Rhodosporidiobolus Geoffroae
Rhodosporidiobolus azoricus
Rhodosporidium fluviale
Rhodosporidiobolus microsporus
Rhodosporidiobolus poonsokiae
Rhodosporidiobolus ruineniae
CGMCC2.3531
Rhodosporidiobolus jianfalingensis sp. nov.
CGMCC2.3532T
CGMCC2.3531
Rhodosporidiobolus platycladi sp. nov. CGMCC2.3118T
CGMCC2.2286
Rhodosporidiobolus nylandii
Rhodosporidiobolus odoratus
Heitmania castanopsis
Heitmania sp. CGMCC2.3440
Heitmania sp. CGMCC2.3624
Heitmania eliacocarpî
Heitmania litseae
Heitmania cylindrica sp. nov. CGMCC2.5650T
Heitmania tridentata sp. nov. CGMCC2.5602T

Fig. 5. (Continued).
Fig. 5. (Continued).
DIVERSITY AND PHYLOGENY OF BASIDIOMYCETOUS YEASTS

Fig. 5. (Continued.)
Fig. 5. (Continued).
Fig. 6. Phylogenetic tree inferred using the combined sequences of SSU rDNA, LSU rDNA D1/D2 domains and ITS region (including 5.8S rDNA), depicting the phylogenetic positions of Lichenozyma and new taxa (in bold) within Cystobasidiomycetes (Pucciniomycotina). The tree was constructed using maximum likelihood analysis and over 50% from 1000 bootstrap replicates is shown. Bar = 0.02 substitutions per nucleotide position.
The novel genera Begerowomyces and Robertozyma, represented by CGMCC 2.4451 and CGMCC 2.3164, respectively, were closely related to Occultifur, Cystobasidium and two monophyletic genera, Queiroziella and Halobasidium, described by Crous et al. (2018) and Guo et al. (2019), respectively, as two separated branches in the Cystobasidiomycetes (Figs 4A and S2A), which indicated that they did not belong to the genera Occultifur, Cystobasidium, Queiroziella or Halobasidium. The BLASTn results showed that CGMCC 2.3164 and CGMCC 2.4451 had less than 90–93 % and 87–91 % (with 91 % coverage) similarities with other genera in Cystobasidiomycetes, such as Occultifur, Cystobasidium and Symmetrospora, in the D1/D2 and ITS regions, respectively. The sequence similarities between CGMCC 2.4451 and CGMCC 2.3164 were 93.6 % and 88.2 % in the D1/D2 and ITS regions, respectively. The BLASTn results showed that CGMCC 2.3164 and CGMCC 2.4451 had less than 90–93 % and 87–91 % (with 91 % coverage) similarities with other genera in Cystobasidiomycetes, such as Occultifur, Cystobasidium and Symmetrospora, in the D1/D2 and ITS regions, respectively. The sequence similarities between CGMCC 2.4451 and CGMCC 2.3164 were 93.6 % and 88.2 % in the D1/D2 and ITS regions, respectively.

The novel genus Pseudosterigmatospora and Sterigmatospora, represented by CGMCC 2.5817 and CGMCC 2.5816, respectively, were located in the Agaricostilbomycetes and closely related to Jianyuinia sakaguchii (Figs 4A and S2A). BLASTn searches of the D1/D2 sequences showed that CGMCC 2.5817 and CGMCC 2.5816 had the highest match with Ben- singtonia rectispora with less than 90 % coverage and 90 % similarity. CGMCC 2.5817 had the highest match with species of Ballistosporomycetes with 50 % coverage and less than 91 % similarity when using ITS sequences as query. However, CGMCC 2.5816 was more related to species of Ruinenia with less than 50 % coverage and 90 % similarity. CGMCC 2.5817 and CGMCC 2.5816 have 91.8 % and 65.5 % similarities in the D1/D2 and ITS regions, respectively. The low similarities in the above analyses indicated that CGMCC 2.5817 and CGMCC 2.5816 were separated and did not belong to any existing genus in the Agaricostilbomycetes. The phylogenetic analysis based on the combined three rDNA loci and seven-genes datasets showed that CGMCC 2.5817, CGMCC 2.5816 and J. sakaguchii formed a clade separated from other families in the Agaricostilbales. Because only J. sakaguchii occurred in the new “Agaricostilbales family 2”, recognised by the nested analyses of the GMYC approach, this new family was not proposed by Wang et al. (2015b). It is now appropriate to proposed the “Agaricostilbales family 2” as a new family, named as Jianyuiniaceae, in this study with two novel genera Pseudosterigmatospora and Sterigmatospora included in this clade.

The novel genus Boekhoutia, represented by CGMCC 2.4539, was closely related to Kurtzmanomyces and Chionosphaera. A BLASTn search of the D1/D2 sequence of CGMCC 2.4539 revealed that the closest match was Kurtzmanomyces shapotouensis with 99 % coverage and 87 % similarity. However, the closest matches using the ITS sequence were the species of Cystobasidiopsis with 71 % coverage and less than 82 % similarity. The results of the BLASTn searches indicated that the phylogenetic position of CGMCC 2.4539 is unclear. In order to clarify its position, the phylogenetic analyses were performed based on different datasets using different algorithms (Figs 4A, S2A). CGMCC 2.4539 was located in the family Cionosphaeraceae as an isolated branch and loosely related to the genera Chionosphaera and Kurtzmanomyces without support in the tree from the single D1/D2 dataset (Fig. 5A). However, CGMCC 2.4539 formed a clade with Cystobasidiopsis in the ITS tree with 86 % bootstrap support (data not shown). CGMCC 2.4539 clustered with Kurtzmanomyces without support as a separated long branch in the tree of the combined three rDNA dataset (Fig. S2A), and located in a separated bottom branch from Kurtzmanomyces and Chionosphaera in the tree of the seven-genes dataset (Fig. 4A). The above analyses indicated that placing CGMCC 2.4539 into Chionosphaera and Kurtzmanomyces is arbitrary. Therefore, a new genus, Boekhoutia, is proposed to accommodate this strain.

The novel genus Meniscomyces, represented by CGMCC 2.5818, was located in the Spiculigloeomycetes (Figs 4A and S2A). The ITS and D1/D2 sequences of CGMCC 2.5818 are very divergent from other yeast species. A BLASTn search of the D1/D2 sequences revealed that CGMCC 2.5818 matched with Phyllozyma with less than 70 % coverage and 82–83 % similarity, and genera, such as Tremella, in the Tremellomycetes (Agaricomycotina) with 79–81 % similarity. Only the 5.8S region of the ITS sequence of CGMCC 2.5818 matched with some taxa in the Pucciniomycotina and Agaricomycotina, such as Crusto- derma and Tygervalleyomycetes, using ITS sequences as the query. A BLASTn search of the SSU sequences showed that CGMCC 2.5818 matched to the taxa in Pucciniomycotina, with Phyllozyma as the best match with 89 % similarity. The phylogenetic analyses based on different datasets (Figs 4, 5 and S2) showed that CGMCC 2.5818 is related to Phyllozyma, Mycogloea sp. TUB F040962 and Spiculigloea sp. TUB RB1040 in the Spiculigloeomycetes, with Spiculigloea sp. TUB RB1040 as its closes relative (Fig. 5). Because sequences of only a few Spiculigloea and Mycogloea species are available at present, it is difficult to elucidate the higher taxonomic position of CGMCC 2.5818. Consequently, CGMCC 2.5818 was placed in a new genus Meniscomyces (see Taxonomy section), which is temporarily treated as ‘incertae sedis’ in the Spiculigloeomycetes.

The novel genus Rosettozyma, represented by the groups of CGMCC 2.2615, CGMCC 2.3466 and CGMCC 2.5819, located in a separated clade at the bottom of the tree, is separated from all known orders and other taxa in the Microbotryomycetes (Figs 4A and S2A). A BLASTn search of the D1/D2 and ITS sequences revealed that these three groups matched to the genera in the Microbotryomycetes, such as Rhodotorula, Chrysozyma, Oberwinkleromyza, Phenolfera, Vonarxula and Yunzhangia, with 86–89 % and 84–94 % similarities (42–59 % coverage), respectively, which are below the fungal order thresholds of 94.7 % for D1/D2 and 81.2 % for ITS, recommended by Vu et al. (2016). The phylogenetic analysis and the comparison of predicted taxonomic thresholds indicated that the CGMCC 2.2615, CGMCC 2.3466 and CGMCC 2.5819 groups could represent a new order. Therefore, Rosettozyma, Rosettozymaceae and Rosettozymales are proposed (see Taxonomy section).

The genus Heitmania belongs to the Microbotryomycetes, but no higher categories were assigned to place this genus in although it represents an isolated clade in the Micro- botryomycetes (Liu et al. 2017). Two new species of Heitmania are proposed in this study that represented a subclade that was separated from the already described species in the trees constructed from the different datasets (Figs 4A and S2A). The phylogenetic analysis based on the increased number of sampled species showed that this genus was more related to the order Sporidiobolales than the other taxa in the Micro- botryomycetes in the tree of the three rDNA loci dataset
(Fig. S2), but located in a separated branch from other existing orders in the Microbotryomycetes in the tree of the seven-genomes dataset (Fig. 4) agreeing with the result from Liu et al. (2017). The genus Heitmania had a less than 93 % similarity with other taxa in the Microbotryomycetes in the D1/D2 domains and 82–88 % (60–78 % coverage) in the ITS region. The above data indicated that a new order could be circumscribed to accommodate the genus Heitmania. Therefore, Heitmaniae and Heitmaniales are proposed in the Taxonomy section.

Some novel species described latter were represented by a single strain or a few of isolates. In order to find potentially conspecific strains of different origin for those new species, we used the ITS and D1/D2 sequences of those species to blast the similar sequences against GenBank, The Yeasts Trust database or MycoBank (Robert et al. 2005, http://www.mycobank.org/). Sixty identical or similar sequences, which are from 46 unpublished strains and 14 uncultured fungus clones, were added in the new species delimitation below.

New species identification in the Tremellomycetes (Agaricomycotina)

Kockovaella (Cuniculitremaceae, Tremellales)

Five strains, isolated from Yunnan and Hainan provinces, South China, were located in the Kockovaella clade as three separate groups that were also separated from other species of Kockovaella (Figs 2B, 3B and S1B). Groups CGMCC 2.3443 and CGMCC 2.3536, both containing two strains, clustered together in the tree constructed by the seven-genomes and three rDNA loci datasets (Figs 2B and S1B) and were most closely related to Kockovaella libkindii in the tree drawn by the D1/D2 dataset (Fig. 3B). Strains in the CGMCC 2.3443 group have identical ITS and D1/D2 sequences, which indicated that they are conspecific. Strains in the CGMCC 2.3536 group, also with identical ITS and D1/D2 sequences, differed from the CGMCC 2.3443 group by 12 nucleotides (nt) (~2 %) substitutions in the D1/D2 domains and 16 nt (~3.2 %) mismatches (including substitutions and deletions) in the ITS regions. These two groups differed from Koc. libkindii by three nt (~0.5 %) and 11–17 nt (~2.2–3.4 %) mismatches in the D1/D2 and ITS regions, respectively. Strain CGMCC 2.3465 was placed in the Kockovaella clade (Fig. 2B) as a separated branch at the bottom of the clade. It differed from other Kockovaella species by more than 3 % and 7 % mismatches in the D1/D2 and ITS regions, respectively.

The above sequence comparisons indicated that the five novel strains represent three novel species in the genus Kockovaella.

Genolevuria (Bulleraceae, Tremellales)

CGMCC 2.5809 has a close relationship with Genolevuria amylyolitica and Genolevuria tibetensis (Figs 2B, 3C and S1B). They differed from each other by 10–15 nt (~2–3 %) substitutions and ~10 % mismatches in the D1/D2 and ITS regions, respectively. Therefore, CGMCC 2.5809 is proposed as a new species in the genus Genolevuria.

Vishniacozyma (Bulleraceae, Tremellales)

Six strains formed three groups, represented by CGMCC 2.3099, CGMCC 2.3472 and CGMCC 2.3165, in the Vishniacozyma clade (Figs 2B and S1B). Group CGMCC 2.3472, consisting of three strains, possessed similar sequences with one nt and five nt difference in the D1/D2 and ITS regions, respectively, which indicated they were conspecific. An isolate IA19 (KM246197/KM246114) named as ‘Cryptococcus dimennae’ in the GenBank database had identical or similar D1/D2 sequences (zero to one nt difference) with the CGMCC 2.3472 group, however, there were nine to ten nt (~1.9–2.0 %) differences in the ITS regions, which indicated that the isolate IA19 may represent a different taxon and is not conspecific to the strains of the CGMCC 2.3472 group. The CGMCC 2.3472 group was closely related to Vishniacozyma nebularis, Vishniacozyma dimennae and Vishniacozyma globispora (Figs 2B, 3F and S1F), which differed from the three known species by 9–28 nt (~1.5–4 %) substitutions in the D1/D2 domains and by more than 9 % mismatches in ITS regions. More than seven nt (~1.1 %) D1/D2 sequence difference were observed between group CGMCC 2.3472 and other eight undescribed or erroneously identified strains (Fig. S1F), which indicated that those strains represent different species from group CGMCC 2.3472. Group CGMCC 2.3099 was more closely related to Vishniacozyma folicilia and Vishniacozyma heimaeyensis (Figs 2B and S1F). They differed from V. folicilia and V. heimaeyensis by seven to ten nt (~1.1–1.6 %) substitutions in the D1/D2 domains and by 15–18 nt (~3 %) mismatches in the ITS region. The two strains in the CGMCC 2.3165 group had identical sequences in the ITS and D1/D2 regions. They also had the same ITS sequences as ‘Cryptococcus’ sp. SJ8L03 (FJ153171) and SJ8L02 (FJ153172), and a similar ITS (four nt difference) and D1/D2 sequences (one nt difference) as ‘Cryptococcus’ sp. KY763 (AB428345/AB428344). A Blast search against The Yeasts Trust database (or MycoBank) showed that CBS 8412 isolated from food in the Netherlands and CBS 9328 isolated from soil in Costa Rica have similar D1/D2 sequences (99.68–99.84 %) and ITS sequences (99.45 %) with CGMCC 2.3165 group. The above analysis indicated that they should be conspecific. The CGMCC 2.3165 group differed from CGMCC 2.3099, V. folicilia and V. heimaeyensis by 8–11 nt (~1.3–1.8 %) mismatches in the D1/D2 domains, and by more than 5 % nucleotide divergence in the ITS region.

Based on the above sequence comparisons, those six strains should represent three novel species in the genus Vishniacozyma.

Carlosrosaea (Trimorphomycetaceae, Tremellales)

The genus Carlosrosaea was circumscribed with a single species Carlosrosaea vrieseae (Liu et al. 2015b). Recently, Felix et al. (2017) described two novel species, namely Carlosrosaea hoherbergiae and Carlosrosaea aechmeae. Strains from all three species were isolated from bromeliads in Brazil (Landell et al. 2015, Felix et al. 2017). Two Chinese isolates, CGMCC 2.3580 isolated from Yunnan province and CGMCC 2.3447 isolated from Hainan province, were placed in the genus Carlosrosaea with an affinity to Ca. vrieseae based on phylogenetic analysis of the sequences of the ITS and D1/D2 regions (Fig. 3C). They differed from Ca. vrieseae by 11–13 nt (~1.8–2.2 %) substitutions in the D1/D2 domains, and by more than 9 % mismatches in the ITS regions. CGMCC 2.3580 and CGMCC 2.3447 differed from each other by 12 nt (~2 %) substitutions and more than 12 % mismatches in the D1/D2 and ITS regions, respectively.
The above analyses indicated that the two novel strains represent two undescribed Carlosrosaea species.

Note: An uncultured fungal clone 2170_736 (KP891580) from Scolytus multistriatus, Sweden, has an identical ITS sequence with CGMCC 2.3447, which indicates that the species represented by CGMCC 2.3447 is also distributed outside of China.

Saitozyma (Trimorphophycetaceae, Tremellales)
CGMCC 2.5811, located in the genus Saitozyma was closely related to Saitozyma flava in the tree obtained from the combined seven-genes dataset (Fig. 2C). Although they differed from each other by only two nt in the D1/D2 domains, there were 14 nt in the ITS region, which indicated that CGMCC 2.5811 was not conspecific with Sa. flava. More than seven nt D1/D2 heterogeneity (~1.1 %) were observed between CGMCC 2.5811, Saitozyma paraflava and the potential new species from Thailand and Japan (Fig. 3C). The above analyses indicated that CGMCC 2.5811 represented a novel Saitozyma species.

Note: The monophyly of Saitozyma was not supported by this study (Fig. 2C), which need more robust data and species to confirm.

Tremella (Tremellaceae, Tremellales)
CGMCC 2.5615 had the closest relationship with Tremella globo-sipora (Figs 2B and 3F). They differed from each other by seven nt (~1.1 %) substitutions in the D1/D2 domains and 17 nt (~2.1 %) substitutions in the ITS region. Thus, it should be proposed as a new species in Tremella.

Kwoniella (Cryptococcaceae, Tremellales)
Kwoniella (Cryptococcaceae, Tremellales)
CGMCC 2.3439 was placed in the Kwoniella clade with an affinity to Kwoniella endophytica, Kwoniella botswanaensis, Kwoniella mangrovensis, Kwoniella pini, Kwoniella dejecticola, Kwoniella dendrophila and Kwoniella shivaji in the trees from the D1/D2 as well as the three rDNA and seven-genes datasets (Figs 2C, 3G and S1C). It differed from those six species by 11–18 nt (~2.3–3.7 %) substitutions in the D1/D2 domains and 7 % mismatches in the ITS region. The analysis of the ITS and D1/D2 sequences indicated that CGMCC 2.3439 belongs to a novel species within Kwoniella.

Teunia (Cryptococcaceae, Tremellales)
CGMCC 2.3835, CGMCC 2.4450 and CGMCC 2.5648 formed a separate branch in the tree of the three rDNA and seven-genes datasets, and were located in the genus Teunia, a clade newly named in this study (Figs 2C and S1C). CGMCC 2.5648 was closely related to the misidentified strain ‘Psikrozyma taiwanensis’ CBS 9926 (KY102949/KY107271) and ‘Cryptococcus’ sp. F6 (AY518273/AY508880) with two nt differences in the D1/D2 domains and 12–17 nt (~2.1–3 %) mismatches in the ITS regions, which indicated that they probably belong to different species. CGMCC 2.3835 and CGMCC 2.4450 differed from their closest undescribed or erroneously identified strains, ‘Fonseca- zyma’ sp. 2154 (MK400702), ‘Kwoniella’ sp. PY016 (KY399877), ‘Kwoniella’ sp. HB31-3 (KJ507251), ‘Cryptococcus’ sp. BI226 (EU678944), ‘Cryptococcus’ sp. SAP963.4 (JX078703), ‘Cryptococcus’ sp. RT 1.5.17 (AY731785) and ‘Cryptococcus heveaensis’ YM25139 (JQ964208) (Fig. 3G), by 8–13 nt (~1.3–2 %) substitutions in the D1/D2 domains.

The above sequence comparisons proved that the three new strains belong to three novel species in the genus Teunia.

Note: Based on the D1/D2 sequences comparisons, more than 30 undescribed or erroneously identified strains may represent more than 20 species in Teunia clade (Fig. 3G), which need to be clarified in the future because the ITS sequences are not available at present.

Dioszegia (Bulleribasidiaceae, Tremellales)
Seven strains with orange-coloured colonies distributed in five groups located in the Dioszegia clade (Figs 2C, 3D and S1C). Group CGMCC 2.5628 was closely related to Dioszegia crocea and Dioszegia aurantiaca and differed from them by 12–13 nt (~1.9–2.1 %) in the D1/D2 domains and 8–11 nt (~1.7–2.3 %) mismatches in the ITS region. Three strains in group CGMCC 2.5674 had identical sequence in the ITS and D1/D2 regions. They differed from Dioszegia cryoxerica and Dioszegia chang-baiensis by 13–16 nt (~2.1–2.6 %) in the D1/D2 domains and about 5 % mismatches in the ITS region. Groups CGMCC 2.3625, CGMCC 2.5658 and CGMCC 2.4537 formed three separate branches, clustering with Dioszegia athyrii, Dioszegia catarinioi, Dioszegia takashimae and Di. zsolti. Group CGMCC 2.3625 and an unpublished strain, TY-217 (AY313036/AY313016) possessed similar sequences with only one and three nt differences in the D1/D2 and ITS regions, respectively, which indicated that they are conspecific. Group CGMCC 2.3625 differed from these four known species (Fig. 3D) by zero to five nt and more than 21 nt (~4 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.5658 differed from these four known species by one to five nt in D1/D2 domains and 11–15 nt (~2.1–3 %) mismatches in the ITS regions. Group CGMCC 2.4537 differed from them by five to ten nt (~0.8–1.6 %) and more than 33 nt (~6 %) mismatches in the ITS and D1/D2 regions, respectively. An uncultured fungal clone CMH458 (KF800549) from indoor air in Kansas City, Missouri, USA had an identical ITS sequence as CGMCC 2.4537, which indicated that this species may be common in different locations.

According to the above sequence analyses five novel species in the genus Dioszegia are proposed in the Taxonomy section.

Bulleribasidium (Bulleribasidiaceae, Tremellales)
Seven strains formed five groups in the genus Bulleribasidium, represented by CGMCC 2.4024, CGMCC 2.4427, CGMCC 2.5812, CGMCC 2.4428 and CGMCC 2.3320 (Figs 2D, 3D and S1D). One nt difference was found in the D1/D2 domains between two strains in the CGMCC 2.4024 group. This group differed from its closest relative Bulleribasidium panici by three to four nt (~0.6 %) substitutions in the D1/D2 domains and nine nt (~1.8 %) mismatches in the ITS regions. Groups CGMCC 2.4427 and CGMCC 2.5812 were most closely related to Bulleribasidium setariae. CGMCC 2.5812 differed from Bu. setariae by nine nt (~1.5 %) and 16 nt (~2.6 %) mismatches in the D1/D2 and ITS regions, respectively. Group 2.4427 had 45 nt (~7.4 %) differences in the D1/D2 domains and ~19 % in the ITS regions from Bu. setariae. Groups CGMCC 2.3320 and CGMCC 2.4428 had an affinity to Bulleribasidium foliicola. Group CGMCC 2.3320 consisted of two strains with similar D1/D2 (one nt difference) and ITS sequences (three nt differences). A Blast search against The Yeasts Trust database showed that two strains, BSB09 (KY305125) isolated from bromeliad, Brazil and TY-199...
(AY313030) found in the phyllosphere of Thailand have 99.5–99.8 % sequences similarity with the CGMCC 2.3320 group in the ITS region, which indicated that they are conspecific. They differed from Bu. folicola by three to four nt (~0.6 %) in the D1/D2 domains and nine to ten (~1.7–1.9 %) mismatches in the ITS regions. Group CGMCC 2.4428 had a greater sequence disparity with Bu. folicola with 19 nt (~3.1 %) difference in the D1/D2 domains and more than 11 % in the ITS region.

The above sequence comparisons indicated that these seven novel strains represent five undescribed species of *Bulleribasidium*.

**Dexomyces (Bulleribasidiaceae, Tremellales)**

Twenty three strains separated in twelve groups located in the *Dexomyces* clade (Figs 2D, 3E and S1D). Three strains in group CGMCC 2.5660 differed from each other by one nt in both the D1/D2 and ITS regions. This group differed from its closest relative *Dexomyces linthienensis* by 23 nt (~4 %) in the D1/D2 domains and more than 9 % mismatches in the ITS regions. Groups CGMCC 2.3572 and CGMCC 2.4429 were closely related to *Dexomyces hubeiensis* (Figs 2D and S1D). Strains in the CGMCC 2.4429 group had similar sequences with three nt differences in the ITS region, which indicated that they are conspecific. They differed from group CGMCC 2.3572 by two to four nt in the D1/D2 domains and 14–17 nt (~2.7–3.3 %) mismatches in the ITS regions. These two groups differed from *De. hubeiensis* by 13–15 nt (~2.1–2.4 %) in the D1/D2 domains and more than 6 % mismatches in the ITS regions. Group CGMCC 2.3459 contained three strains with identical ITS and D1/D2 sequences and were closely related to *Dexomyces schimicola* and *Dexomyces pseudoschimicola*. The former differed from the known two species by six to seven nt (~1.0 %) in the D1/D2 domains and 8–18 nt (~1.4–3.0 %) mismatches in the ITS regions. Group CGMCC 2.2459 was closely related to *Dexomyces cylindricus*, and differed from it by four nt (~0.6 %) and 11 nt (~2.2 %) mismatches in the D1/D2 and ITS regions, respectively. These two groups CGMCC 2.4436 and CGMCC 2.4437 were most closely related to *Dexomyces boekhoutii* (Fig. S1D). These two groups differed from each other by three nt (~0.5 %) and 18 nt (~3.5 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.4436 differed from *De. boekhoutii* by three nt (~0.5 %) and 12 nt (~2.4 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.4437 and *De. boekhoutii* had two nt and 16 nt (~3.1 %) differences in the D1/D2 and ITS regions, respectively. Group CGMCC 2.3561 derived from *Dexomyces wuzhishanensis* by seven nt (~1.1 %) and 18 nt (~3.5 %) mismatches in the D1/D2 and ITS regions, respectively. Four groups represented by CGMCC 2.3535, CGMCC 2.3563, CGMCC 2.3470 and CGMCC 2.4446 were closely related to *Dexomyces yunnanensis*. Group CGMCC 2.3535 and *De. yunnanensis* had identical D1/D2 sequences, and 10 nt (~1.9 %) differences in the ITS region, which indicated that they represent different taxa. Group CGMCC 2.3563 contained six strains that do not have more than three nt differences in both the ITS and D1/D2 regions, which indicated that they are conspecific. Group CGMCC 2.3470 comprised two strains with two nt differences in the ITS regions. The two strains in group CGMCC 2.4446 possessed identical sequences. Groups CGMCC 2.4446 and CGMCC 2.3470 differed by one nt and 13 nt (~2.5 %) mismatches in the D1/D2 and ITS regions, respectively. These four groups and *De. yunnanensis* differed from one another by zero to four nt in the D1/D2 domains and 9–23 nt (~1.8–4.5 %) mismatches in the ITS region.

Based on the above sequence comparisons twelve novel species of *Dexomyces* are proposed in the Taxonomy section. Note: An uncultured fungal isolate, OTU 265 (KT328670) from coffee leaf infected by an rust fungus (*Hemileia vastatrix*), Finca Don Julio, USA, has one nt difference with CGMCC 2.4446 in the ITS region, which indicated that this species may be also found in the USA.

**Phaeotremella (Phaeotremellaceae, Tremellales)**

The BLASTn searches of the D1/D2 and ITS regions revealed that the strains CGMCC 2.5810 and CGMCC 2.5614 belonged to *Phaeotremella*, with the best matches *Phaeotremella foliacea* CBS 5029 (previously named as *Phaeotremella Skinneri*, Spirin et al. 2018) and five ‘Cryptococcus’ spp. with 98.6–98.2 % similarity in the D1/D2 domains and 94 % similarity in the ITS regions. CGMCC 2.5810 and CGMCC 2.5614 formed a subclade with the unpublished strains TFL2B (MG909557/KY614525), ‘Tremella’ sp. H-080.13 (AY188379) and ‘Cryptococcus’ sp. CBS11775 (LT904718/FN824502) in the tree of the D1/D2 dataset (Fig. 3H). CGMCC 2.5614 differed from these unpublished strains by five to ten nt substitutions in the D1/D2 domains and by 15–17 nt (~3–3.4 %) mismatches in the ITS regions, which indicated that they belong to different species. CGMCC 2.5810 and CGMCC 2.5614 differed from TFL2B by 11–12 nt in the D1/D2 domains and more than 6 % mismatches in the ITS regions. CGMCC 2.5614 differed from *Pha. foliacea* (*Pha. skinneri*) and *Pha. foliacea* (voucher Miettinen 14610) by 33–37 nt (~6.6–7.4 %) mismatches in the ITS regions and 15–16 nt substitutions (~2.4–2.6 %) in the D1/D2 domains. CGMCC 2.5810 differed from *Pha. foliacea* (*Pha. skinneri*), *Pha. foliacea* (voucher Miettinen 14610) and ‘Cryptococcus’ sp. GT-388 (HQ890369) by 8–10 nt (~1.3–1.6 %) in the D1/D2 domains, and more than 5 % mismatches in the ITS regions.

The above data indicated that CGMCC 2.5810 and CGMCC 2.5614 represent two novel species of *Phaeotremella*. Note: An uncultured Tremellales clone, 5_D20 (HQ211529) from Arctic soil, Canada has 99.4 % ITS sequence similarity with CGMCC 2.5810 by blast search against the MycoBank database, which indicated that this species may be also found in other locations than China.

**Holtermannia (Holtermanniaceae, Holtermanniales)**

Four isolates, CGMCC 2.3445, CGMCC 2.3460, CGMCC 2.3462 and WZS12.12B, isolated from plant leaves collected in Yunnan province clustered in the genus *Holtermannia* (Wuczkowski et al. 2011) in the tree obtained from the three rDNA and seven-genes datasets (Figs 2E and S1E). Similar sequences were found between these four strains with no more than 3 nt differences in the ITS and D1/D2 regions. They differed from *Holtermannia corniformis* by five to six nt (~1 %) substitutions in the D1/D2 domains and 23–25 nt (~4 %) mismatches in the ITS region, which indicated that they represent a new species of *Holtermannia*. Note: An uncultured endophytic fungal clone, WFC36 (KF709568) isolated from *Warburgia ugandensis* in Austria has two nt difference with group CGMCC 2.3445 in the ITS region, which indicated that this new species should be found outside of China. Two strains ‘Holtermannia corniformis’ MB128 (KC798426) and JMJ1 (KCS10049), have identical or very
similar D1/D2 sequences, which indicated that they are conspecific.

**Solicoccozyma (Piskurozymaceae, Filobasidioides)**

CGMCC 2.5814 and CGMCC 2.4893 had ten nt constituting indels in the ITS regions and identical sequence in the D1/D2 domains. Similar sequences with zero to one nt difference in the D1/D2 and ITS regions were found between CGMCC 2.5814 and ‘Solicoccozyma aerea’ CBS 9627 (KY105431/KY109663) and RUB096 (MK397489). Solicoccozyma sp. DBVPG10727 (MK070335/MK070317) and ‘Cryptococcus’ sp. CRUB 2005 (KF828509). So these six strains were considered to be conspecific. They differed from the type strain of Solicoccozyma aerea by 19 nt (~3 %) in the D1/D2 domains, and more than 4 % mismatches in the ITS regions. Therefore, a novel species of Solicoccozyma is proposed to accommodate them (Figs 2E and 3J).

**Note:** The uncultured eukaryote clone LTSP_EUKA_P5P23 (FJ554237) collected from the long-term soil productivity (LTSP) in Skulow Lake in Canada, had the same ITS sequence as CGMCC 2.4893. CGMCC 2.5814 and seven uncultured clones, clone 81a17 (EU554946) and clone 54a11 (EU554878) collected from soil of nptII transformed poplar plantation in Canada, clone LTSP_EUKA_P4M17 (FJ553878) from LTSP from Skulow Lake in Canada, clone BF-OTU106 (AM901762) from house dust in Finland, clone C4 6B (GU366710) from temperate forest soil in USA, clone 3200K2 (KF617524) from Picea mariana forest soil mineral horizon in Bonanza Creek LTER, Alaska, USA, and clone N131 (JF300706) from boreal forest soil in Sweden, contain identical or only one nt difference in the ITS regions. Based on the comparison of environmental DNA sequences, the novel species (see **Taxonomy** section) is commonly and abundantly found in diverse locations.

**Filobasidium (Filobasidiaceae, Filobasidioides)**

CGMCC 2.5649 and GPS23.2A5 have identical sequences and differed from other Filobasidium species by 19 nt (~3 %) in the D1/D2 domains and more than 11 % mismatches in the ITS region, which indicated that they represent a novel species in Filobasidium. Seven isolates, CGMCC 2.3463, CGMCC 2.3464, CGMCC 2.4012, CGMCC 2.4052, CGMCC 2.5680, CGMCC 2.5656 and KTA01-11.64, formed a separate subclade distinguished from the other Filobasidium species (Figs 2E and 3J). CGMCC 2.3464 differed from CGMCC 2.4012, CGMCC 2.4052 and KTA01-11.64 by two nt in the D1/D2 domains and five nt in the ITS regions. CGMCC 2.5656 and CGMCC 2.5680 with identical ITS and D1/D2 sequences differed from the above three strains by one to two nt in the D1/D2 domains, and by 29–33 nt (~5 %) mismatches in the ITS regions. CGMCC 2.3463 differed from the above two groups, represented by CGMCC 2.4012 and CGMCC 2.5680, by five to six nt substitutions in the D1/D2 domains and more than 16 % mismatches in the ITS regions. The ITS and D1/D2 sequence comparisons indicated that these seven strains could be classified into three distinct species. Therefore, three novel species are proposed to accommodate the groups CGMCC 2.5680, CGMCC 2.4012 and CGMCC 2.3463.

**Note:** Three strains, ‘Cryptococcus’ sp. SC15d50p10-8 (HQ631032) isolated from *Saccharum officinarum* in USA, O382A (JX394019) isolated from tree hollows in Brazil and CBS 10181 (EU002869/EU002805) isolated in Portugal, differ from group CGMCC 2.4012 by one to three nt in ITS region or two nt in D1/D2 domains, which indicated that they are conspecific.

**Phaffia (Makraeiaceae, Cystofilobasidioides)**

Strain CGMCC 2.5601 was placed in the genus Phaffia (Figs 2E, 3K and S1E). It differed from *Phaffia rhodozyma* by three nt substitutions in the D1/D2 domains and 7 % mismatches in the ITS regions. Although more than four potentially new species in this genus should be described (David-Palma et al. 2014, Fig. S3), only one species, *P. rhodozyma*, is accepted in this genus (Liu et al. 2015b). Therefore, the second Phaffia species is proposed to accommodate CGMCC 2.5601 as a novel species to improve the species diversity in *Phaffia*.

**New species identification in the Agaricostilbomycetes (Pucciniomycotina)**

**Kondoa (Kondoaceae, Agaricostilbales)**

Fifteen strains, representing ten candidate novel species, were placed in the *Kondoa* clade (Figs 4B, 5B and S2B). Group CGMCC 2.3102, containing three strains with one nt substitution in the D1/D2 domains, had identical ITS sequences with strain PYCC 5566 (AF444672) and one nt D1/D2 sequences difference (AF444766), which indicated that they were conspecific. This group differed from its closest relative *Kondoa aeria* by two nt and 41 nt (~6 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.2652, consisting of two strains with identical sequences, was closely related to *Kondoa subrosea* and differed from it by ten nt (~1.6 %) and 50 nt (~8 %) mismatches in the D1/D2 and ITS regions, respectively. Groups CGMCC 2.2621, including two strains with identical sequences, and CGMCC 2.3100 were closely related to *Kondoa sorbi* (Figs 4B and S2B). These two groups differed from *K. sorbi* by 25 nt (~4 %) in the D1/D2 domains and greater than 122 nt (~18 %) mismatches in the ITS region. Group CGMCC 2.2621 showed five nt differences in the D1/D2 domains and more than 12 % differences in the ITS region. Group CGMCC 2.2762 showed high affinity to *Kondoa changbaicensis* and differed from it by three nt substitutions and 32 nt (~5 %) mismatches in the D1/D2 and ITS region, respectively.

Groups CGMCC 2.4441, including two strains with two nt differences in the ITS regions, CGMCC 2.5610, containing two strains with one nt substitution in the D1/D2 domains, and
CGMCC 2.3106 were closely related to Kondoa gutianensis. These three groups differed from Kon. gutianensis by 9–15 nt (−1.4–2.4 %) in the D1/D2 domains and more than 75 nt (−12 %) mismatches in the ITS region. CGMCC 2.3106 and the unpublished strain Kondoa sp. AS4583 (FN428954) isolated from flower of Dianthus superbus had identical D1/D2 sequences and three nt differences in the ITS region, which indicated that they are conspecific. An uncultured corn field bulk soil clone 05D70C34 (HG937064) collected from Göttingen, Lower Saxony, Germany, and CGMCC 2.3106 had three nt differences in the ITS regions, which indicated that this candidate novel species occurs in the soil environment. Similar sequences were found between CGMCC 2.3106, CBS 8379 and the unnamed strain, Kondoa sp. ZP 352 (AY512854) with one nt substitutions in the D1/D2 domains. CGMCC 2.3106 differed from CBS 8379 (AF444596), ZP 352 (MN175326) and ZP 338 (MN175325) by two nt substitutions and five indels in the ITS region, which indicated that they may be conspecific.

Group CGMCC 2.2763 was placed in a separate branch in the trees obtained from the rDNA and seven-genes datasets (Figs 4B and S2B). This group differed from other species of Kondoa by −20 % mismatches in the D1/D2 domains and with even greater diversity in the ITS regions.

The above phylogenetic analysis indicated that these fifteen strains represent nine novel species in Kondoa.

**Bensingtonia (Kondoaceae, Agaricostilbales)**

Strains CGMCC 2.5677 and CGMCC 2.3569 were placed in two separate branches in the genus Bensingtonia (Figs 4B and S2B). CGMCC 2.5677 was closely related to Bensingtonia naga-noensis and Bensingtonia pseudonaganensis, and differed from them by four to seven nt substitutions in the D1/D2 domains and 52–60 nt (−8–9 %) mismatches in the ITS regions. CGMCC 2.3569 had affinity to Bensingtonia bomiensis and Bensingtonia pseudonaganensis (Fig. 5B). 20 nt (~3.2 %) differences in the D1/D2 domains and 93–101 nt (~14–15 %) differences in the ITS regions were observed between them.

Based on the analysis of the ITS and D1/D2 sequences two novel species of Bensingtonia, are proposed to accommodate CGMCC 2.3569 and CGMCC 2.5677.

**Pseudobensingtonia (Agaricostilbaceae, Agaricostilbales)**

CGMCC 2.5815, CGMCC 2.5823 and XZ152B1 have identical sequences and were placed in the Pseudobensingtonia clade (Figs 4B, S2B). They differed from Pseudobensingtonia ingoldii and Pseudobensingtonia musae by 23–24 nt (~4 %) in the D1/D2 domains and 87–94 nt (~14–15 %) mismatches in the ITS regions. Therefore, a new species of Pseudobensingtonia is proposed to accommodate these three strains.

**Ruinenia (Ruineniaceae, Agaricostilbales)**

Four strains were placed in three separate branches in the Ruinenia clade (Figs 4B, S2B). Group CGMCC 2.4426 contained two strains with identical D1/D2 and ITS sequences. This group differed from the undescribed strains, ‘Sporobolomyces’ sp. TY-139 (AY313063/AY313037), ‘Ruinenia’ sp. TW 1.1F038 (KP020109), ‘Ruinenia’ sp. TW 2.1E-026 (KP020111), ‘Ruinenia’ sp. TW 2.1E-041 (KP020112) and ‘Ruinenia’ sp. TW 2.1E012 (KP020114), by 6–9 (~1–1.4 %) mismatches in the ITS regions, which indicated that these unpublished strains may represent different species. Group CGMCC 2.4426 was closely related to Ruinenia clavata (Figs 4B and S2B) and differed from Ru. clavata by more than 34 nt (~5.5 %) and 90 nt (~14.5 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.3454 and Ruinenia clavata formed a clade (Fig. 5C). They differed from each other by 31 nt (~5 %) in the D1/D2 domains and 111 nt (~17 %) in the ITS regions. Group CGMCC 2.4542 differed from its closest relative Ruinenia dracophylly by 13nt (~2 %) and 27 nt (~4 %) mismatches in the D1/D2 and ITS regions, respectively.

Based on the above phylogenetic analysis three novel Ruinenia species are proposed.

**Boekhoutia (Chionospheraeaceae, Agaricostilbales)**

This circumscription of new genera in the above section showed that strain CGMCC 2.4539 represents a novel genus, Boekhoutia. Consequently, a new species name for CGMCC 2.4539 is proposed in the Taxonomy section.

Note: The unpublished strain Kurtzmanomyces sp. YM25263 (KT345339) isolated from Yunnan province, China, was closely related to CGMCC 2.4539 in the tree of the D1/D2 dataset (Fig. 5A), which indicated that this strain represents a new member of Boekhoutia.

**Sterigmatospora (Jianyuniaceae, Agaricostilbales)**

Strain CGMCC 2.5817 has been proposed in the above circumscription of new genera to represent the new genus Sterigmatospora. Therefore, a novel species name is proposed to accommodate this strain.

Note: Strain RP146, namely Pucciniomycotina sp. (AB727125), isolated from Japan (Takashima et al. 2012) clustered with CGMCC 2.5817 in the tree of the D1/D2 dataset (Fig. 5A), which indicated that this strain represents a member of Sterigmatospora.

**Pseudosterigmatospora (Jianyuniaceae, Agaricostilbales)**

CGMCC 2.5816 represented the new monotypic genus Pse- duosterigmatospora, that was closely related to Sterigmatosporaspora in the new circumscribed family Jianyuniaceae (Figs 4B and S2B). A new species name is proposed for CGMCC 2.5816.

Note: ‘Bensingtonia’ sp. BI183 (EU678947), an unpublished species isolated from Brazil, was closely related to CGMCC 2.5816 in the tree drawn from the D1/D2 dataset (Fig. 5A).

**New species identification in the Spiculogloeomycetes (Pucciniomycotina)**

**Phyllozyma (Spiculogloeaceae, Spiculogloeales)**

CGMCC 2.5669 was closely related to Phyllozyma coralina and Phyllozyma dimenaeae (Figs 4B, S2B) and differed from them by 17–18 nt (~3 %) substitutions in the D1/D2 domains, and 41–47 nt (~6.2–7.2 %) mismatches in the ITS region. Strains CGMCC 2.2662 and CGMCC 2.2617 had two nt differences in the ITS region and differed from their closest relative Phyllozyma coprosmicola by seven (~1.1 %) and eight nt (~1.5 %) substitutions in the D1/D2 and ITS regions, respectively.

The above data indicated that these three strains represented two new species in Phyllozyma.
Meniscomyces (incertae sedis, Spiculogloeomycetes)

CGMCC 2.5818 and CGMCC 2.5681 have identical D1/D2 and ITS sequences. They belong to the new genus Meniscomyces (Figs 4B and S2B). A new species name is proposed to accommodate these two strains.

Note: An uncultured fungal clone, 103 NA2 P31 C4 (KF297104) from a soil sample in Ellef Ringnes Island, Canada, was closely related to CGMCC 2.5681 and CGMCC 2.5818 in the tree drawn from the D1/D2 dataset (Fig. 5A), which indicated that other Meniscomyces species may occur in nature.

New species identification in the Cystobasidiomycetes (Pucciniomycotina)

Sakaguchia (Sakaguchiaeaceae, incertae sedis)

CGMCC 2.4235 (= JCM 8162 = CBS 5143) was named as Rhodotorula araucariae in the chemotaxonomic studies of basidiomycetous yeasts (Sugiyama et al. 1985, Hamamoto et al. 1986a,b). The result from Gadanho & Sampaio (2002) indicated that IGC 5612 (= CBS 5143) was closely related to CGMCC 2.4235, which indicated they may be conspecific.

The above data indicated that these strains represented two novel species of Cystobasidium.

Note: CGMCC 2.3822 and the published strain TP-Snow-Y153 (JQ768912) had three nt differences in the D1/D2 domains, which indicated that they may be conspecific.

Robertozyma (incertae sedis, Cystobasidiales)

CGMCC 2.4451 and CGMCC 2.4452 had identical D1/D2 and ITS sequences. They belong to the newly described genus Robertozyma (Figs 4C, 5D and S2C). A new species is proposed to accommodate these two strains.

Begerowomyces (incertae sedis, Cystobasidiales)

The genus Begerowomyces, represented by CGMCC 2.3164, is proposed in this study (Figs 4C, 5D and S2C). Consequently, a new species name is proposed later.

Lichenozyma and Halobasidium (incertae sedis)

The genus Lichenozyma has been proposed to accommodate yeasts isolated from and detected in the lichen Cladonia samples (Černáková & Skaloud, 2019). Interestingly, these yeasts have been reported as common inhabitants of lichens in Europe and USA (Spröbile et al. 2016, Černáková & Skaloud, 2019). Some yeasts detected as a part of symbiotic three-partner system in the cortex of ascomycete macrolichens by Spröbile et al. (2016). Although Spröbile et al. (2016) suggested in their highly cited paper that these yeasts are possibly unculturable lichen associates, seven living axenic cultures have been obtained from air-dried Cladonia thalli by Černáková & Skaloud (2019).

Phylogenetically Lichenozyma has been placed inside the genus Microsporomycetes (Černáková & Skaloud, 2019). It is important to note that although, the dataset used by Černáková & Skaloud (2019) was largely based on the seven-genes (Wang et al. 2015a,b), all yeasts from lichens in the analysis contained predominantly ITS sequences. Only four isolates contained all three rDNA loci, ITS, LSU and SSU. No sequence of...
protein-coding genes has been obtained for the genus *Lichenozyma* or other lichenicolous fungi, including yeasts from ascomycete macrolichens ([Spribille et al. 2016] and *Cyphobasidium* [Millanes et al. 2016]). As the result, phylogenetic analyses inferred with Bayesian Inference and Maximum Likelihood algorithms gave different topologies and several lineages identified previously identified by Wang et al. (2015a,b) has not been resolved by Černajová & Škaloud (2019). The subsequent analysis of the three rDNA loci (consisting mainly of ITS sequences) suggested that the genus *Microsporomyces* is polyphyletic and supported the erection of the *Lichenozyma*. The fact that monophyly of the *Microsporomyces* clade received no statistical support (both BI and ML) can be explained with very poor taxon sampling in both genus *Microsporomyces* and outgroups.

We included available LSU, SSU and ITS sequences of *Lichenozyma pisutiana* in our combined three rDNA loci, combined ITS and LSU and LSU datasets. Our analyses demonstrated that *Lichenozyma pisutiana* was placed inside the genus *Microsporomyces* with high statistical support. The genus *Microsporomyces* was resolved with high statistical support in the combined three rDNA loci and combined ITS (ML: 100 %) and LSU (ML: 99 %) trees (Figs 6 and S5, S6). Our analyses do not support a separate phylogenetic position of the genus *Lichenozyma*. Therefore, the *Lichenozyma* species should be transferred into *Microsporomyces* as synonym.

The genus *Halobasidium* has been proposed to accommodate a single yeast isolate from pickling sauce for a traditional high-salt fermented food in China (Guo et al. 2015a). Although the presented phylogenetic tree clearly showed a separated phylogenetic position of the *Halobasidium xiangyangense*, the tree is very poor in terms of taxon sampling. The analysis did not include 9 out of 18 Cystobasidium species (C. alpinum, C. fimetarium, C. halotolerans, C. iromotensis, C. keelungensis, C. oligophagum, C. ongulense, C. portilloniense, and C. tubaki), including the type species of the genus *C. fimetarium, Occultifur mephitis*, and numerous sequences representing yet undescribed yeast species in Cystobasidiales. Among sequences representing potential new taxa in Cystobasidiales, *Cystobasidiomycetes* sp. DSM 28479 (NCBI Taxonomy ID 1524830) and JS-40 (NCBI Taxonomy ID 1082630) showed 99 and 97 % (LSU) and 97 and 95 % (ITS) similarity to *C. tubaki* DSM 28479 (NCBI Taxonomy ID 1524830) and JS-40 (NCBI Taxonomy ID 1082630) showed 99 and 97 % similarity to *C. tubaki* DSM 28479 (NCBI Taxonomy ID 1524830) and JS-40. These yeasts are likely to represent closely related species (DSM 28479) or conspecífic isolates (JS-40). It is important to note that *Cystobasidiomycetes* sp. DSM 28479 (cited as *Rhodotorula* sp. MB27) has been found to be the closest outgroup to the Cystobasidium - *Occultifur* clade by Yurkov et al. (2015b). Phylogenetic placement presented by Guo et al. (2019) contradicts larger phylogenetic analyses published by Yurkov et al. (2015b), who showed that LSU and combined rDNA phylogenies are able to resolve genera Cystobasidium, *Occultifur* and *Rhodotorula* sp. MB27.

Phylogenetic analysis performed in the present study showed that LSU alone is not sufficient to resolve genera in Cystobasidiaceae, including *Cystobasidium, Halobasidium, Occultifur, Queiroziella* and newly proposed *Begerowomyces* and *Robertozyma* (Fig. S5). Combined phylogenetic analyses of the rDNA citron and the seven-genes analysis resolved this genus with good statistical support (Fig. 4A). The constrained LSU analysis confirmed that the two aforementioned Cystobasidiomycetes belong to the genus *Halobasidium* (Figs 5D and S5).

With these examples we would like to show that good taxon sampling is essential for phylogenetic studies and taxonomy of basidiomycetous yeasts. A particular attention should be given to newly erected monotypic yeast genera, which should be preferably circumscribed using multi-gene phylogenies, as in the case of recent descriptions of genera *Heitmania*, *Libkindia* and *Yurkovia* (Liu et al. 2017, Mašinová et al. 2017).

**New species identification in the Microbotryomycetes (Pucciniomycotina)**

*Sporobolomyces* (Sporidiobolaceae, Sporidiobolales)

Three groups, represented by CGMCC 2.3532, CGMCC 2.4435 and CGMCC 2.3118, were located in the *Rhodospiridobolus* clade (Figs 4D, 5E and S2D). Group CGMCC 2.3532, containing two strains with identical sequences, clustered with *Rhodosporidiobolus poonsookiae* and *Rhodosporidiobolus ruineniae* without support in the tree obtained from the D1/D2 dataset (Fig. 5E), but it was located in a different place in the trees of the three rDNA loci and seven-genes datasets (Figs 4D and S2D). The BLASTn searches of the ITS and D1/D2 indicated that CGMCC 2.3532 are more related to *Rh. ruineniae* than other species. This group differed from *Rh. ruineniae* by 16 nt (~3 %) in the D1/D2 domains and 32 nt (~5 %) mismatches in the ITS region. Group CGMCC 2.4435, consisting of three strains with one nt difference in the D1/D2 domains, differed from its closest relative, *Rhodosporidiobolus lusitaniae* by eight nt (~1.3 %) and 22 nt (~4 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.3118 was most closely related to *Rhodosporidiobolus nylandii* and differed from it by five nt and 14 nt (~3 %) mismatches in the D1/D2 and ITS regions, respectively.

The sequence comparisons showed that these three groups represent three distinct novel species in *Rhodospiridobolus*.

**Note:** Three unpublished strains ‘Sporobolomyces’ sp. Vega180 (EU002899), ‘Sporobolomyces’ sp. Vega122 (EU009966) and *Rhodosporidiobolus* sp. Vega175 (MG471376) isolated from Coffea in Puerto Rico, USA, and *Rhodosporidiobolus odoratus* AUMC 10780 (KY495748) isolated from fresh guava juice collected from shops in Assisi city, Egypt, had one to two nt difference from CGMCC 2.3118 in the ITS region, which indicated that they are conspecific. ‘Sporobolomyces’ sp. ST-88 (DQ404450) and ‘Sporobolomyces’ sp. ST-90 (DQ404451) differed from CGMCC 2.3532 group by three to five nt in the D1/D2 domains, however, the ITS sequences of those two strains are not available. Therefore, the taxonomic positions of those two strains were not delineated.

*Sporobolomyces* (Sporidiobolaceae, Sporidiobolales)

Twelve strains forming four groups clustered in the genus *Sporobolomyces* based on the sequence analysis of the seven genes and rDNA loci datasets (Figs 4D, 5E and S2D). CGMCC 2.5675, CGMCC 2.5687 and two published strains, ‘Sporobolomyces aff. jilinensis’ MCA 3774 (JN942193/JN940715) and MCA 3785 (JN942199/JN940720) had identical D1/D2 and ITS sequences. They differed from *Sporobolomyces jilinensis* by 12 nt (~2 %) and 10 nt (~1.7 %) mismatches in the D1/D2 and ITS regions, respectively. Groups CGMCC 2.5627 represented
Microbotryozyma collariae, a new species is suggested to accommodate these two strains. The differences between CGMCC 2.5662 and CGMCC 2.5627 differed from these two species by two to three nt in the D1/D2 domains and nine nt (~1.5 %) in the ITS regions. Group CGMCC 2.5619 differed from them by five to six nt (~1 %) in the D1/D2 domains and 19 nt (~3 %) in the ITS regions. The two new groups differed from each other by four nt and 18 nt (~3 %) in the D1/D2 and ITS regions, respectively. Based on the above sequence analyses three novel species of Sporobolomyces, are proposed to accommodate the groups CGMCC 2.5675, CGMCC 2.5627 and CGMCC 2.5619.

The placement of IAM 13481 was not stable in the trees from the three datasets (Figs 4D, 5E and S2D). The BLAST searches of the ITS and D1/D2 sequences showed that IAM 13481 had the highest match with Sporobolomyces ruberimis and differed from it by 12 nt (~2 %) in both the D1/D2 and ITS regions. Originally IAM 13481 (= YK 419) was designated as Sporobolomyces roseus (Yamazaki & Komagata, 1983). Valério et al. (2008) indicated that this strain was incorrectly named and did not belong to Sp. roseus. Since then this strain was treated as an unnamed taxon of Sporobolomyces (Valério et al. 2008). However, the genome of this strain (http://genome.jgi.doe.gov/pages/search-for-genes.jsf?organism=Sporo1b) had been sequenced by the Joint Genome Institute (http://www.jgi.doe.gov) ten years ago, which was the first Pucciniomycotina species with a genome sequence. After the genome was released, the genetic and genomic studies of degrading myco-toxin and mating type genes in the basidiomycetous yeasts based on this strain have been reported (Coelho et al. 2008, 2011, Ianiri et al. 2013, 2016). Unfortunately, a formal name has been unavailable for this strain until now, therefore, a new species name of Sporobolomyces is proposed to accommodate it.

Heitmania (Heitmaniaceae, Heitmaniales)
Two isolates, CGMCC 2.5602 and CGMCC 2.5650, formed a subclade in Heitmania (Figs 4D and S2D). These two strains differed from each other by four nt substitutions and 40 nt (~6 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.5602 differed from the other Heitmania species, Heitmania illiseae, Heitmania elacocarp and Heitmania castanopis, by six to eight nt (~1.0–1.4 %) substitutions and 86 nt (~14 %) mismatches in the D1/D2 and ITS regions, respectively. The differences between CGMCC 2.5650 and the other three known Heitmania species ranged between four to six nt in the D1/D2 domains and were greater than 15 % in the ITS regions. Two novel species are suggested to accommodate these two strains.

Microbotryozyma (Ustilentlylomataceae, Microbotryales)
The genus Microbotryozyma contains a single species, namely Microbotryozyma collariae, and was located in the family Ustilentlylomataceae (Figs 4A, 5F and S2E). Strain CGMCC 2.3533 differed from Mi. collariae by six nt (~1 %) and 57 nt (~11 %) in the D1/D2 and ITS regions, respectively. Therefore, a novel species is suggested to accommodate this strain.

Yamadamycyes (Kriegeriaceae, Kriegeriales)
CGMCC 2.5820 clustered with the monotypic genus Yamadamycyes in the trees obtained from the seven-genesis as well as three rDNA loci datasets (Figs 4E and S2E). One nt difference in the D1/D2 domains and 56 nt (~10 %) mismatches in the ITS regions were found between CGMCC 2.5820 and Yamadamycyes rosulatus, which indicated that CGMCC 2.5820 could represent a novel Yamadamycyes species.

Oberwinklerozyyma (incertae sedis)
Groups CGMCC 2.3441 and CGMCC 2.5824 were located in the Oberwinklerozyyma clade (Figs 4E, 5G and S2E). CGMCC 2.5824 and four unpublished strains labeled as ‘Rhodotorula’ sp. n-w29 (LC326052) and ‘Rhodotorula’ sp. B157 (EU678941), Chrysozymaceae sp. SJ13L05 (EU523609/FJ153202) and ‘Rhodotorula’ sp. KY23L16 (HO623608/FJ527098) contained identical sequences in the D1/D2 domains, and the latter two strains had two to three nt substitutions with CGMCC 2.5824 in the ITS regions, which indicated that they are conspecific. They differed from Oberwinklerozyyma yarowii by seven nt (~1.2 %) and more than 40 nt (~6 %) mismatches in the D1/D2 and ITS regions, respectively. CGMCC 2.3441 occupied a separated bottom branch in the Oberwinklerozyyma clade. It differed from the other Oberwinklerozyyma species by more than six nt (~1 %) in the D1/D2 domains and 68 nt (~11 %) mismatches in the ITS regions, respectively.

The phylogenetic analysis showed that these strains represented two novel species in Oberwinklerozyyma.

Chrysozyma (Chrysozymaceae, incertae sedis)
The genus Chrysozyma, containing the two species Chrysozyma griseoflava and Chrysozyma fushanensis, was recently proposed (Wang et al. 2015b) based on the phylogenetic analysis of seven genes. Thirteen strains formed eight groups and were all closely related to Ch. griseoflava (Figs 4E, 5H and S2E). Group CGMCC 2.5629 consisted of three strains that had one nt difference in the D1/D2 domains. They differed from Ch. griseoflava by seven nt (~1.1 %) and nine nt (~1.3 %) substitutions in the D1/D2 and ITS regions, respectively. Groups CGMCC 2.2618 and CGMCC 2.2765, both containing two strains with identical sequences, differed from Ch. griseoflava by three to nine nt (~0.5–1.5 %) and 20–54 nt (~3–8 %) mismatches in the D1/D2 and ITS regions, respectively. Two strains in the CGMCC 2.2768 group had similar sequences with two nt and four nt in the D1/D2 and ITS regions, respectively. Six nt differences in the D1/D2 domains and 64 nt (~9 %) in the ITS regions were found between the CGMCC 2.2768 group and Ch. griseoflava. Groups CGMCC 2.5821, CGMCC 2.2769 and CGMCC 2.3455, all represented by only a single strain, differed from Ch. griseoflava by two to four nt in the D1/D2 domains and 71–75 nt (~10–11 %) mismatches in the ITS regions. Group CGMCC 2.5611 and ‘Rhodotorula’ sp. DSM 101778 (KX067789) published by Prior et al. (2017), had three nt differences in the ITS regions, which indicated that they are conspecific. This group differed from Ch. griseoflava by 11 nt (~1.8 %) and 84 nt (~14 %) mismatches in the D1/D2 and ITS regions, respectively.

The above sequence comparisons indicated that these eight groups represent eight novel taxa in Chrysozyma.
Yurkovia (Chrysozymaceae, incertae sedis)

Analysis of the sequences of the ITS region and D1/D2 domains suggested that CGMCC 2.5603 has affinity to the genus Yurkovia (Masínová et al. 2017) (Figs 4E, 5H and S2E). Four nt and 40 nt (−7 %) differences in the D1/D2 and ITS regions, respectively, were observed between CGMCC 2.5603 and Yurkovia mendeliana. CGMCC 2.5603 had identical sequences as Yurkovia nerthusi in the D1/D2 domains, however, they differed from each other by 39 (−6 %) mismatches in the ITS region, which indicated that CGMCC 2.5603 represents a novel species in Yurkovia.

Pseudohyphozyma (incertae sedis)

The seven strains CGMCC 2.2612, CGMCC 2.2796, CGMCC 2.2797, CGMCC 2.5607, CGMCC 2.5618, CGMCC 2.5623 and GPS23.3D2 were located in the Pseudohyphozyma clade, forming two groups (Figs 4E, 5H and S2E). Group CGMCC 2.2612 and Pseudohyphozyma bogoriensis differed from each other by four nt and 22 nt (−4 %) mismatches in the D1/D2 and ITS regions, respectively. Group CGMCC 2.2796 contained six strains with one nt difference in the ITS regions and differed from its closest relative Pseudohyphozyma pustula by five nt and 22 nt (−4 %) mismatches in the D1/D2 and ITS regions, respectively. The above sequence comparisons indicated that these seven strains represent two novel species in Pseudohyphozyma.

Sloofia (incertae sedis)

Strain CGMCC 2.5822 was placed in the genus Sloofia with 100 % bootstrap support (Figs 4E, 5H and S2E). It had identical D1/D2 sequences with Sloofia tsgae and 37 nt (−5 %) differences in the ITS region, which indicated that CGMCC 2.5822 represents a different species.

Colacogloea (Colacogloeaceae, incertae sedis)

Eight strains formed three groups in the Colacogloea clade (Figs 4E, 5G and S2E). Group CGMCC 2.2766 differed from its closest relative Colacogloea cycloclastica by 32 nt (−5 %) in the D1/D2 domains and more than 13 % mismatches in the ITS region. Groups CGMCC 2.2798 and CGMCC 2.2770, consisting of six strains with one nt and two nt difference in the D1/D2 and ITS regions, respectively, were closely related to Colacogloea diffusa. The two groups differed from Co. diffusa by 22–26 nt (−3.6–−4.3 %) in the D1/D2 domains, and more than 14 % mismatches in the ITS regions. Groups CGMCC 2.2798 and CGMCC 2.2770 differed from each other by 26 nt (−4.3 %) substitutions and 8.8 % mismatches in the D1/D2 and ITS regions, respectively. The sequence comparisons indicated that these eight strains represent three novel species in Colacogloea.

Rosettozyma (Rosettozymaceae, Rosettozymales)

Six strains, separated in three groups were located in the newly circumscribed genus Rosettozyma (Figs 4E, 5G and S2E). CGMCC 2.3446, CGMCC 2.3461 and CGMCC 2.3466 had one nt difference in the D1/D2 domains and shared the same ITS sequences, which indicated that they are conspecific. CGMCC 2.2615 and CGMCC 2.2619 had one and three nt differences in the D1/D2 and ITS regions, respectively, which indicated that they belong to the same species. Group CGMCC 2.2615 differed from the CGMCC 2.3446 group by four to six nt and 12–14 nt (−2–2.3 %) mismatches in the D1/D2 and ITS regions, respectively. CGMCC 2.5819 differed from groups CGMCC 2.2615 and CGMCC 2.3446 by 28–30 nt (−4.7–−5 %) in the D1/D2 domains and 30–43 nt (−5–7.2 %) mismatches in the ITS regions.

The above data indicated that these six strains represent three novel Rosettozyma species.

Taxonomy

New taxa in Tremellomycetes (Agaricomycotina)

Kockovaella haikouensis Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828736. Fig. 7A, B.

Etymology: The specific epithet haikouensis refers to the geographic origin of the type strain, Haikou county, Hainan.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal or ovoid, 1.8–3.5 × 2.5–5.0 μm and single, budding is polar (Fig. 7A), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-cream, butyrous, smooth and glis- tening. The margin is entire. In Dalmau plate culture on CM, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal or some what kidney-shaped, 3.3–5.0 × 5.0–8.3 μm (Fig. 7B).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, soluble starch (variable), D-xylose (variable), L-arabinose (variable), D-ribose, D-glucosamine, N-Acetyl-D-glucosamine, ethanol (variable), glycerol (variable), erythritol (variable), ribitol (variable), galactitol, D-mannitol, methyl α-D-glucoside, salicin, DL-lactate(variable), succinate (variable) are assimilated as sole carbon sources. L-sorbose, inulin, D-arabinose, L-rhamnose, methanol, D-glucitol, citrate, myo-inositol and heptadecane are not assimilated. Ammonium sulfate, L-lysine (variable), ethylamine hydrochloride (delayed) and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive. The major ubiquinone is Q-10.

Physiologically, Koc. haikouensis differs from the closely related species Koc. ischaemi in its inability to assimilate inulin, D-arabinose, L-rhamnose and sodium nitrite and its ability to assimilate ethylamine (Table S1.1).

Typus: China, Haikou county, Hainan province, obtained from a leaf of an unidentified plant. Nov. 2006. Q.-M. Wang (holotype CGMCC 2.3443) preserved in a metabolically inactive state, ex-type CBS 15478 = HKX2.

Kockovaella ischaemi Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828738. Fig. 7C, D.

Etymology: the specific epithet ischaemi refers to Ischaemum, the plant genus from which the type strain was isolated.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal or ovoid, 2.0–3.8 × 2.3–6.2 μm and single or pairs, budding is polar (Fig. 7C), blastoconidia are produced on short stalk-like conidiophores, a sediment is formed. After 1 mo at
17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-cream, butyrous, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal or some what kidney-shaped, 2.0–3.7 × 4.2–6.7 μm (Fig. 7D).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin, soluble starch, D-xylose, L-arabinose, D-arabinose (weak), D-ribose, L-rihamnose, D-glucosamine, N-Acetyl-D-glucosamine, glycerol (variable), ribitol (variable), galactitol, D-mannitol, Methyl-α-D-glucoside (variable), salicin (weak), succinate (weak), citrate (variable) and myo-inositol (variable) are assimilated as sole carbon sources. L-sorbose, methanol, ethanol, erythritol, D-glucitol, DL-lactate and hexadecane are not assimilated. Ammonium sulfate, sodium nitrite and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine (weak), ethylamine hydrochloride and D-glucitol, Methyl-α-D-glucoside, salicin, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine (weak), ethylamine hydrochloride (weak) and cadaverine dihydrochloride (weak) are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 37 °C. Growth in vitamin-free medium is positive (weak). Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive. The major ubiquinone is Q-10.

Physiologically, **Koc. haikouensis** differs from the closely related species, **Koc. ischaemi**, **Koc. haikouensis**, **Koc. simaoensis**, **Koc. thailandica** and **Koc. imperatae**, in its inability to assimilate cellobiose, melibiose, D-glucosamine, N-Acetyl-D-glucosamine and D-mannitol and its ability to assimilate potassium nitrate (Table S1.1).

**Typus:** China, Wuzhishan mountain, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3465T preserved in a metabolically inactive state, ex-type CBS 15487 = WZS12.1).

Genolevuria pseudoamylolytica Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828740. Fig. 7F.

**Etyymology:** the specific epithet *pseudoamylolytica* refers to the similar colony morphology to that of *Genolevuria amyloptyla*.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal and subglobular, 2.9–5.2 × 3.3–7.7 μm and single, budding is polar (Fig. 7F), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, mucoid, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin (weak), soluble starch, D-xylose (weak), L-arabinose, D-ribose (weak), D-ribose (weak) and DL-lactate (weak) are assimilated as sole carbon sources. L-sorbose, cellobiose, lactose, melibiose, D-glucosamine, N-Acetyl-D-glucosamine, D-mannitol, Methyl-α-D-glucoside, salicin, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine (weak), ethylamine hydrochloride (weak) and cadaverine dihydrochloride (weak) are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 37 °C. Growth in vitamin-free medium is positive (weak). Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive. The major ubiquinone is Q-10.

Physiologically, *Koc. nitrophila* differs from its five closely related species, *Koc. ischaemi*, *Koc. haikouensis*, *Koc. sacchari*, *Koc. thailandica* and *Koc. imperatae*, in its inability to assimilate cellobiose, melibiose, D-glucosamine, N-Acetyl-D-glucosamine and D-mannitol and its ability to assimilate potassium nitrate (Table S1.1).

**Typus:** China, Wuzhishan mountain, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3465T preserved in a metabolically inactive state, ex-type CBS 15487 = WZS12.1).

Genolevuria pseudoamylolytica Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828740. Fig. 7F.

**Etyymology:** the specific epithet *pseudoamylolytica* refers to the similar colony morphology to that of *Genolevuria amyloptyla*.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal and subglobular, 2.9–5.2 × 3.3–7.7 μm and single, budding is polar (Fig. 7F), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, mucoid, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin (weak), soluble starch, D-xylose (weak), L-arabinose, D-ribose (weak), D-ribose (weak), D-glucosamine, N-Acetyl-D-glucosamine, D-mannitol (weak), D-glucitol (weak), Methyl-α-D-glucoside and salicin are assimilated as sole carbon sources. Methanol, ethanol, glycerol, erythritol, ribitol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, N-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin (weak), soluble starch, D-xylose (weak), L-arabinose, D-ribose, D-ribose, L-rihamnose (weak), D-glucosamine, N-Acetyl-D-glucosamine, D-mannitol (weak), D-glucitol (weak), Methyl-α-D-glucoside and salicin are assimilated as sole carbon sources. Methanol, ethanol, glycerol, erythritol, ribitol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *G. pseudoamylolytica* differs from the two closely related species, *G. amyloptyla* and *G. ibetensis*, in its inability to assimilate ribitol and succinate and the ability to assimilate L-sorbos and potassium nitrate (Table S1.2).
**Typos:** China, Daliangzi river national forest park, Heilongjiang province, obtained from a leaf of an unidentified plant, Aug. 2014, Q.-M. Wang (holotype CGMCC 2.5809T preserved in a metabolically inactive state, ex-type CBS 13955 = HLJ1B6).

**Tremella shuangheensis** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828741. Fig. 7G.

*Etymology:* the specific epithet *shuangheensis* refers to the geographic origin of the type strain, Shuanghe county, Heilongjiang.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosoidal and ellipsoidal, 3.2–4.6 × 4.0–5.5 μm and single, budding is polar (Fig. 7G), a sediment is present. After 1 mo at 17 °C, a ring and sediment are polar. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-cream, mucoid, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudothecae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbos (delayed and weak), sucrose, maltose, cellobiose, trehalose, lactose, raffinose, melezitose, inulin (variable), D-xyllose, L-arabinose, D-ribonose (variable), D-ribose (variable), L-rhamnose, N-Acetyl-D-glucosamine (variable), D-glucosamine (variable), ethanol, glycerol, ribitol (variable), galactitol (variable), D-mannitol, D-glucitol (variable). Methyl-α-D-glucoside (variable), salicin (weak), succinate (variable) and myo-inositol (variable) are assimilated as sole carbon sources. Melibiose, soluble starch, methanol, erythritol, D-glucuronate, DL-lactate, citrate and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (variable), L-lysine, ethylamine hydrochloride (variable) and cadaverine dihydrochloride (variable) are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is variable. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *V. melezitolytica* differs from the closely related species *V. dimennae* and *V. globispora* in its inability to assimilate DL-lactate and citrate and its ability to assimilate melezitose (Table S1.4).

**Typos:** China, Hebei province, obtained from a leaf of an unidentified plant, Apr. 2007, Q.-M. Wang (holotype CGMCC 2.3472T preserved in a metabolically inactive state, ex-type CBS 15490 = H5A3).

**Vishniacozyma pseudopenaeus** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828743. Fig. 7I.

*Etymology:* the specific epithet *pseudopenaeus* refers to the similar colony morphology and physiological characteristics to that of *Vishniacozyma peneus.*

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosoidal and ellipsoidal, 2.6–3.5 × 2.8–5.0 μm and single, budding is polar (Fig. 7I), a sediment is formed. After 1 mo at 17 °C, a pellicle and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale grayish-cream, mucoid, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudothecae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbos (variable), sucrose, maltose, cellobiose, trehalose, lactose, raffinose, melezitose, inulin (variable), D-xyllose, L-arabinose, D-ribonose (variable), D-ribose (variable), L-rhamnose, N-Acetyl-D-glucosamine (variable), D-glucosamine (variable), ethanol, glycerol, ribitol (variable), galactitol (variable), D-mannitol, D-glucitol (variable). Methyl-α-D-glucoside (variable), salicin (weak), succinate (variable) and myo-inositol (variable) are assimilated as sole carbon sources. Melibiose, soluble starch, methanol, erythritol, D-glucuronate, DL-lactate, citrate and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (variable), L-lysine, ethylamine hydrochloride (weak) and cadaverine dihydrochloride (variable) are assimilated as sole nitrogen sources. Sodium nitrite are not assimilated as sole nitrogen sources. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is positive. Starch-like substances are...
produced or not. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *V. pseudopenaeus* differs from the closely related species *V. penaeus* in its ability to grow in vitamin-free medium, however, the latter does not grow in vitamin-free medium (Table S1.4).

**Typus: Germany,** obtained from a leaf of an unidentified plant, Sep. 2005 (holotype CGMCC 2.3165T preserved in a metabolically inactive state, ex-type CBS 15472 = G7.20).

**Vishniacozyma europaea** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828744. Fig. 7J.

**Etymology:** the specific epithet *europaea* refers to the geographic origin of the type strain, Europe.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosal and ellipsoidal, 2.4–4.8 × 3.0–9.6 μm and single, budding is polar (Fig. 7J), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish cream, butyrous, smooth. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, soluble starch, D-xyllose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, ethanol (delayed and weak), glyceraldehyde (delayed and weak), erythritol, ribitol, galactitol (delayed and weak), D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin, DL-lactate, succinate (delayed and weak), citrate (delayed and weak) and myo-inositol (weak) are assimilated as sole carbon sources. L-sorbose, inulin, methanol and hexadecane are not assimilated. Ammonium sulfate is assimilated as sole nitrogen sources. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ca. foliicola* differs from the closely related species *Ca. simaoensis* in its ability to assimilate erythritol (Table S1.5).

**Typus: China,** Wuzhishan mountain, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3447T preserved in a metabolically inactive state, ex-type CBS 15481 = WZS29.4).

**Carlosrosaea simaoensis** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828746. Fig. 7L.

**Etymology:** the specific epithet *simaoensis* refers to the geographic origin of the type strain, Simao county, Yunnan.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal, 2.0–2.6 × 3.3–4.2 μm and single, budding is polar (Fig. 7L), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is white-cream, butyrous, smooth and glossy. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, soluble starch, D-xyllose, L-arabinose, D-arabinose (delayed and weak), D-ribose, L-rhamnose (delayed and weak), D-glucosamine, ethanol, glyceraldehyde, erythritol, ribitol, galactitol (delayed and weak), D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin, DL-lactate (delayed and weak), succinate (weak), citrate and myo-inositol (delayed and weak) are assimilated as sole carbon sources. L-sorbose, inulin, methanol, erythritol and hexadecane are not assimilated. Ammonium sulfate is assimilated as sole nitrogen sources. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ca. foliicola* and *Ca. simaoensis*, and their three closely related species, *Ca. vriesiae*, *Ca. hohenbergiae*...
and Ca. aechmeae, can be distinguished from each other by the ability to assimilate inulin, erythritol, L-lysine and cadaverine and form starch like compounds (Table S1.5).

**Typus: China**, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3580T preserved in a metabolically inactive state, ex-type CBS 15503 = SM8.1).

Kwoniella ovata Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.** MycoBank MB828747. Fig. 7M.

**Etymology**: the specific epithet ovata refers to the ovoid cell morphology of the type strain.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 4.2–6.8 × 5.2–7.9 μm and single, budding is polar (Fig. 7M), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is tannish-white, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, raffinose, melezitose, soluble starch, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, ethanol, glycerol, ribitol (delayed and weak), galactitol, D-mannitol, D-glucitol, Methyl-d-D-glucoside (weak), succinate and myo-inositol (weak) are assimilated as sole carbon sources. L-arabinose, melezitose, inulin, D-glucosamine, methyl, erythritol, salicin, DL-lactate, citrate and hexadecane are not assimilated. Ammonium sulfate, sodium nitrite and L-lysine (weak) are assimilated as sole carbon sources. L-arabinose, D-ribose (delayed), salicin and cadaverine dihydrochloride are not assimilated. Ammonium nitrate, sodium nitrite, L-lysine and cadaverine and form starch like compounds (Table S1.5).

Sexual reproduction not known. Colonies cream to yellow, butyrous to mucoid. Budding cells present. Pseudohyphae and hyphae are not produced. Ballistoconidia are not formed.

**Type species**: Teunia koralensis Q.M. Wang, F.Y. Bai & A.H. Li.

**New species and combinations for Teunia**

Teunia betulae K. Sylvester, Q.M. Wang & Hittinger ex Q.M. Wang, F.Y. Bai & A.H. Li, **sp. nov.** MycoBank MB828752.

For description see FEMS Yeast Res. 15: 7 (2015).

Holotype: NRRL Y-63732 (preserved in a metabolically inactive state).

Synonym: Kwoniella betulae K. Sylvester et al., FEMS Yeast Res. 15: 7 (2015), nom. inval., Art. 40.7 (Shenzhen).

Teunia cuniculi (K.S. Shin & Y.H. Park) Q.M. Wang, F.Y. Bai & A.H. Li, **comb. nov.** MycoBank MB828753.

Basionym: Cryptococcus cuniculi K.S. Shin & Y.H. Park, Int. J. Syst. Evol. Microbiol. 56: 2243 (2006).

Teunia tronadorensis V. de García, Zalar, Brizzo, Gunde-Cim. & van Brook ex Q.M. Wang, F.Y. Bai & A.H. Li, **sp. nov.** MycoBank MB828754.

For description see FEMS Microb. Ecol. 82(2): 536 (2012).

Holotype: CRUB 1299 (preserved in a metabolically inactive state).

Synonym: Cryptococcus tronadorensis V. de García et al., FEMS Microb. Ecol. 82(2): 536 (2012), nom. inval., Art. 40.7 (Shenzhen).

Teunia helanensis Q.M. Wang, F.Y. Bai & A.H. Li, **sp. nov.** MycoBank MB828755. Fig. 7N.

**Etymology**: the specific epithet helanensis refers to the geographic origin of the type strain, Helanshan mountain, Ningxia.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are ovoid, subglobosal and ellipsoidal, 3.0–6.6 × 4.1–6.6 μm and single, budding is polar (Fig. 7N), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-white, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, galactose (delayed), maltose, cellobiose, trehalose, lactose, soluble starch (delayed), D-xylene, L-arabinose (delayed), D-arabinose (delayed), D-ribose (delayed and weak), L-rhamnose, D-glucosamine (delayed), succinate and myo-inositol are assimilated as sole carbon sources. L-arabinose, melezitose, inulin, D-glucosamine, methyl, erythritol, salicin, DL-lactate, citrate and hexadecane are not assimilated. Ammonium sulfate and L-lysine (delayed) are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated.
Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Te. korlaensis* differs from the closely related species *Te. helanensis* in its inability to assimilate sucrose and its ability to assimilate soluble starch, D-arabinose, L-rhamnose, ethanol, erythritol, D-glucitol, succinate and L-lysine (Table S1.7).

**Typus:** *China*, Helanshan mountain, Ningxia province, obtained from soil, Aug. 2009, P.J. Han (holotype CGMCC 2.4450T preserved in a metabolically inactive state, ex-type CBS 12498 = HLS02-1-5).

*Teunia globosa* Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828756. Fig. 7O.

**Etymology:** the specific epithet globosa refers to the globosal vegetative cells of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are globosal, 4.5–8.0 × 5.1–8.0 μm and single, budding is polar (Fig. 7O), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish cream, butyrous, smooth and partly wrinkled, semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose (weak), melezitose (weak), inulin (weak), D-xylene (weak), L-arabinose (weak), D-ribose (delayed and weak), L-rhamnose (weak), galactitol, D-mannitol and salicin (weak) are assimilated as sole carbon sources. L-sorbose, melibiose, raffinose, soluble starch, D-arabinose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, ribitol, erythritol, D-glucitol, Methyl-D-glucoside, D-gluconate, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, ethylamine hydrochloride (weak) and cadaverine dihydrochloride (weak) are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite and L-lysine are not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Te. korlaensis* differs from the closely related species *Te. helanensis* in its inability to assimilate soluble starch, D-arabinose, L-rhamnose, ethanol, erythritol, D-glucitol, succinate and L-lysine and its ability to assimilate sucrose (Table S1.7).

**Typus:** *China*, Korla county, Xinjiang province, obtained from soil, Feb. 2008, Q.-M. Wang (holotype CGMCC 2.3835T preserved in a metabolically inactive state, ex-type CBS 15653 = 141.19).

*Saitozyma pseudoflava* Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828758. Fig. 8A.

**Etymology:** the specific epithet pseudoflava refers to the similar colony morphology to that of *Saitozyma flava*.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosal and ovoid, 3.2–4.3 × 5.2–6.8 μm and single, budding is polar (Fig. 8A), a sediment is formed. After 1 mo at 17 °C, a pellicle and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-carm, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, melibiose (weak), raffinose, melezitose, inulin (weak), D-xylene, L-arabinose, D-arabinose (weak), D-ribose, L-rhamnose (delayed and weak), D-glucosamine (delayed and weak), N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, ribitol, erythritol, D-glucitol, Methyl-D-glucoside, D-gluconate, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine and ethylamine hydrochloride is polar (Fig. 7P), a sediment is formed. After 1 mo at 17 °C, a part ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.
positive. Diazonium Blue B reaction is positive. (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Starch-like substances are produced. Growth on 50 % growth temperature is 23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is negative. Starch-like substances are not assimilated. Maximum growth temperature is 26 °C. Growth in vitamin-free medium is negative. Starch-like substances are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not assimilated. Maximum growth temperature is 26–27 °C.

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, sucrose, (weak), maltose, (weak), cellobiose, trehalose, maltose, α-D-glucoside, salicin, DL-lactate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine and cadaverine dihydrochloride are assimilated as sole nitrogen sources. L-sorbose, lactose, soluble starch, D-ribose, L-rhamnose, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-mannitol, Methyl-α-D-glucoside, salicin, DL-lactate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine and cadaverine dihydrochloride are assimilated as sole nitrogen sources.

Physiologically, *Sa. pseudoflava* differs from its closely related species *Sa. parafflava* and *Sa. flava* in its inability to assimilate cellobiose, trehalose, soluble starch, DL-lactate, succinate and citrate (*Table S1.8*).

**Typos:** *China*, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (*holotype* CGMCC 2.5811<sup>T</sup> preserved in a metabolically inactive state, ex-type CBS 15576 = XZ2001A1).  
*Dioszegia milinica* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828759. *Fig. 8B.*  
**Etymology:** the specific epithet *milinica* refers to the geographic origin of the type strain, Milin county, Tibet.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 2.9–6.4 × 5.0–10.3 μm and single, budding is polar (*Fig. 8B*), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is orange, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, (weak), maltose, (weak), cellobiose, trehalose, maltose, α-D-glucoside, salicin, DL-lactate, succinate and citrate are assimilated as sole carbon sources. L-sorbose, lactose, D-ribose, L-rhamnose, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-mannitol, Methyl-α-D-glucoside, salicin, DL-lactate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrate, potassium nitrate and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Di. heilongjiangensis* differs from the closely related species *Di. changbaiensis* in its inability to assimilate D-ribose, L-rhamnose and D-mannitol and its ability to grow in vitamin-free medium (*Table S1.9*).  
**Typos:** *China*, Chelu county, Heilongjiang province, obtained from a leaf of an unidentified plant, Aug. 2014, Q.-M. Wang (*holotype* CGMCC 2.5674<sup>T</sup> preserved in a metabolically inactive state, ex-type CBS 13957 = HLJ13.24).

**Dioszegia ovata** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828761. *Fig. 8E, F.*  
**Etymology:** the specific epithet *ovata* refers to the ovoid cell morphology of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 2.3–4.6 × 3.8–7.7 μm and single, budding is polar (*Fig. 8E*), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pink to orange, butyrous, smooth. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are globosublobal and subglobosublobal to napiform, 3.1–6.2 × 3.8–6.9 μm (*Fig. 8F*).

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### Diversity and Phylogeny of Basidiomycetous Yeasts

*Dioszegia heilongjiangensis* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828760. *Fig. 8C, D.*  
**Etymology:** the specific epithet *heilongjiangensis* refers to the geographic origin of the type strain, Heilongjiang province.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosublobal and ellipsoidal, 3.2–5.0 × 4.5–7.3 μm and single, budding is polar (*Fig. 8C*), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish to light orange, butyrous, smooth and partly wrinkled. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are subglobosublobal to napiform, 4.0–5.0 × 5.0–6.0 μm (*Fig. 8D*).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose (weak), maltose (weak), cellobiose (weak), trehalose (weak), melibiose, raffinose, meleztose, inulin (weak), D-xylene (delayed), L-arabinose, D-arabinose (delayed and weak), galactitol (weak), D-glucitol, salicin (weak) and succinate are assimilated as sole carbon sources. L-sorbose, lactose, soluble starch, D-ribose, L-rhamnose, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-mannitol, Methyl-α-D-glucoside, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrate and ethylamine hydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Di. ovata* differs from its closely related species *Di. cryoxerica* in its inability to assimilate D-ribose, L-rhamnose and D-mannitol and its ability to grow in vitamin-free medium (*Table S1.9*).

**Typos:** *China*, Milin county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (*holotype* CGMCC 2.5628<sup>T</sup> preserved in a metabolically inactive state, ex-type CBS 15563 = GPS2138B).

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**Fig. 8.** Vegetative cells grown in YM broth for 5 d at 17 °C and ballistoconidia produced on corn meal agar after 7 d at 17 °C. (A) *Sa. pseudoflava* CGMCC 2.5811<sup>T</sup>; (B) *Di. milinica* CGMCC 2.5626<sup>T</sup>; (C, D) *Di. heilongjiangensis* CGMCC 2.5674<sup>T</sup>; (E, F) *Di. ovata* CGMCC 2.5625<sup>T</sup>; (G, H) *Di. madulaiensis* CGMCC 2.4537<sup>T</sup>; (I) *Di. kandeliae* CGMCC 2.5658<sup>T</sup>; (J) *Bu. phyllostachydis* CGMCC 2.5812<sup>T</sup>; (K, L) *Bu. cremeum* CGMCC 2.4427<sup>T</sup>; (M, N) *Bu. pseudopancis* CGMCC 2.4024<sup>T</sup>; (O, P) *Bu. phyllophilum* CGMCC 2.3320<sup>T</sup>. Bars = 10 μm.
Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, L-sorbose (delayed), sucrose, maltose, cellobiose, trehalose, lactose (delayed), melibiose, raffinose, melitzose, soluble starch, D-xylose, L-arabinose, D-arabinose, melezitose, D-glucosamine, D-ribose, D-glucosamine (delayed and weak), metalactose, D-mannitol, Methyl-α-D-glucoside, salicin (weak) and succinate (delayed and weak) are assimilated as sole carbon sources. Inulin, methanol, ethanol, glycerol, erythritol, ribitol, D-glucitol, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and potassium nitrate (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is positive. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urea activity is present. Diazonium Blue B reaction is positive.

Physiologically, *Di. ovata* and the closely related species *Di. maotaiensis*, *Di. kandeliae*, *Di. zsoltii*, *Di. catarinoi*, *Di. takashimae* and *Di. athyrii* can be distinguished from one another. *Di. ovata* differs from the other five species in their ability to grow in vitamin-free medium (Table S1.9).

**Typus: China, Maotai county, Guizhou province, obtained from a leaf of an unidentified plant, Mar. 2012, Q.-M. Wang (holotype CGMCC 2.4537T preserved in a metabolically inactive state, ex-type CBS 15516 = GZMT3A9).**

*Dioszegia kandelae* Q.M. Wang, F.Y. Bai, L.D. Guo & A.H. Li sp. nov. MycoBank MB828763. Fig. 8l.

**Etymology:** the specific epithet *kandelae* refers to *Kandelia*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal to subglobos, 2.5–4.2 × 3.2–5.5 μm and single, budding is polar (Fig. 8l), a ring and a sediment are formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is orange-red, butyrous, smooth and glossy. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, melezitose, inulin (weak), soluble starch (delayed and weak), D-xylose (delayed and weak), L-arabinose (delayed and weak), D-glucosamine (delayed and weak), N-Acetyl-D-glucosamine (delayed and weak), ethanol (delayed and weak), glycerol (delayed and weak), ribitol (delayed and weak) and D-glucitol are assimilated as sole carbon sources. Raffinose, D-arabinose, D-ribose, L-rhamnose, melezitose, erythritol, galactitol, D-mannitol, Methyl-α-D-glucoside, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite and L-lysine are not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urea activity is present. Diazonium Blue B reaction is positive.

Physiologically, *Di. kandeliae* and the closely related species *Di. ovata*, *Di. maotaiensis*, *Di. zsoltii*, *Di. catarinoi*, *Di. takashimae* and *Di. athyrii* can be distinguished from one another. *Di. kandelae* differs from the other six species in its inability to assimilate raffinose and L-rhamnose (Table S1.9).

**Typus: China, Beilunhekou natural reserve, Guangxi province, obtained from a leaf of *Kandelia candel*, Apr. 2014, L.-D. Guo (holotype CGMCC 2.5865T preserved in a metabolically inactive state, ex-type CBS 13951 = 224191).**

*Bulleriasidium phyllostachydis* Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828765. Fig. 8J.

**Etymology:** the specific epithet *phyllostachydis* refers to *Phyllostachys*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobos, ovoid and elipsoidal, 2.6–4.8 × 3.7–11.3 μm and single, budding is polar (Fig. 8J), a sediment is formed. After 1 mo at 17 °C, a pellicle and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellow, butyrous, smooth and glossy. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, melezitose, inulin, soluble starch, D-xylose (delayed and weak), D-arabinose (delayed and weak), D-glucosamine (delayed and weak), N-Acetyl-D-glucosamine (delayed and weak), ethanol (delayed and weak), glycerol (delayed and weak), ribitol (delayed and weak) and D-glucitol are assimilated as sole carbon sources. Raffinose, D-arabinose, D-ribose, L-rhamnose, melezitose, erythritol, galactitol, D-mannitol, Methyl-α-D-glucoside, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, Ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite and L-lysine are not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urea activity is present. Diazonium Blue B reaction is positive.

Physiologically, *Di. ovata*, *Di. maotaiensis*, *Di. kandeliae*, *Di. zsoltii*, *Di. catarinoi*, *Di. takashimae* and *Di. athyrii* can be distinguished from one another. *Di. kandelae* differs from the other six species in its inability to assimilate raffinose and L-rhamnose (Table S1.9).
Physiologically, *Bu. cremeum* differs from its closely related species, *Bu. phyllostachydis*, *Bu. wuzhishanense* and *Bu. setariae*, in its inability to assimilate galactitol, D-mannitol and Methyl-α-D-glucoside (Table S1.10).

**Typus:** China, Taiwan province, obtained from a leaf of an unidentified plant, Aug. 2009, Q.-M. Wang (holotype CGMCC 2.4427T preserved in a metabolically inactive state, ex-type CBS 12487 = TW1.1F-025).

**Bulleribasidium pseudopanici** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828767. Fig. 8M, N.

**Etymology:** the specific epithet *pseudopanici* refers to the similar colony morphology to that of **Bulleribasidium panici**.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 1.7–4.8 × 4.5–8.7 μm and single, budding is polar (Fig. 8K), a sediment is present. After 1 mo at 17 °C, the streak culture is pale-cream, butyrous, slightly wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Bullistoconidia are subglobos or ellipsoidal, 4.4–7.4 × 5.9–7.4 μm (Fig. 8N).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine (weak), N-Acetyl-D-glucosamine (weak), galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside (weak), salicin (weak) and D-glucuronate are assimilated as sole carbon sources. L-sorbose, maltose, lactose, inulin, soluble starch, methanol, ethanol, glycerol, erythritol, ribitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and L-lysine (delayed and weak) are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, amino acids and hexadecane are not assimilated. Ammonium sulfate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Physiologically,** *Bu. phyllostachydis* differs from its closely related species *Bu. setariae* in its inability to assimilate maltose, inulin, DL-lactate, succinate and citrate (Table S1.10).

**Typus:** China, Motuo county, Tibet, obtained from a leaf of *Phyllostachys* sp., Sep. 2014, Q.-M. Wang (holotype CGMCC 2.5812T preserved in a metabolically inactive state, ex-type CBS 15575 = WZ1239E1).

**Bulleribasidium cremeum** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828766. Fig. 8K, L.

**Etymology:** the specific epithet *cremeum* refers to the pale-cream colony morphology.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 1.7–4.8 × 4.5–8.7 μm and single, budding is polar (Fig. 8K), a sediment is present. After 1 mo at 17 °C, the streak culture is pale-cream, butyrous, smooth and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Bullistoconidia are subglobos or ellipsoidal, 4.4–7.4 × 5.9–7.4 μm (Fig. 8N).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, galactitol, D-mannitol, D-glucitol (variable), Methyl-α-D-glucoside, salicin and myo-inositol are assimilated as sole carbon sources. L-sorbose, lactose, inulin, soluble starch, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-glucurate, DL-lactate, succinate, citrate and hexadecane are not assimilated. Ammonium sulfate, L-lysine, ethylamine hydrochloride, cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Physiologically,** *Bu. pseudopanici* differs from its closely related species *Bu. panici* in its inability to assimilate L-sorbose, soluble starch, D-glucosamine, erythritol, ribitol, D-gluconate, DL-lactate and succinate and its ability to form starch like compounds (Table S1.10).

**Typus:** China, Wuzhishan mountain, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.4024T preserved in a metabolically inactive state, ex-type CBS 15510 = WZS17.20).

**Bulleribasidium phyllophilum** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828768. Fig. 8O, P.

**Etymology:** the specific epithet *phyllophilum* refers to leaves, the substrate origin of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 2.0–4.0 × 4.0–9.3 μm and single, budding is polar (Fig. 8O), a sediment is present. After 1 mo at 17 °C, the streak culture is pale-cream, butyrous, smooth and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Bullistoconidia are subglobos or ellipsoidal, 2.0–4.0 × 4.0–9.3 μm and single, budding is polar (Fig. 8K), a sediment is present. After 1 mo at 17 °C, a sediment is present. After 1 mo at 17 °C, a sediment is present. After 1 mo at 17 °C, a sediment is present. After 1 mo at 17 °C, a sediment is present. After 1 mo at 17 °C, a sediment is present.
observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal, subglobose to napiform, 3.8–6.2 × 4.6–6.2 μm (Fig. 8P).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, inulin (variable), soluble starch (variable), D-xylose, L-arabinose, D-arabinose, L-rhamnose, D-glucosamine (weak), N-Acetyl-D-glucosamine (variable), galactitol, D-mannitol, D-glucitol (variable), Methyl-D-glucoside (delayed and weak) and myo-inositol (variable) are assimilated as sole carbon sources. L-sorbose, lactose, D-ribose, methanol, ethanol, glycerol, erythritol, ribitol, salicin, DL-lactate, succinate, citrate and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (variable), D-ribose (delayed and weak), L-rhamnose (delayed and weak), D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-glucitol, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride (delayed and weak), Methyl-D-glucoside (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrate and cadaverine dihydrochloride (variable) are assimilated in sole nitrogen sources. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Bu. phyllophilum* and its closely related species *Bu. foliicola* cannot be distinguished from each other. The former did not grow at 30 °C, but the latter grew weak (Table S1.10).

**Typus:** China, Bangxi county, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (*holotype* CGMCC 2.3320T preserved in a metabolically inactive state, ex-type CBS 15474 = HBX2.8).

**Bulleribasidium elongatum** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828769. Fig. 9A.

*Etymology:* the specific epithet *elongatum* refers to the elongate vegetative cells of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 2.7–4.1 × 6.8–12.5 μm and single, budding is polar (Fig. 9A), a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not observed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, inulin, D-xylose, L-arabinose, D-arabinose, D-ribose (delayed), galactitol (weak), D-mannitol (delayed and weak) and Methyl-D-glucoside are assimilated as sole carbon sources. L-sorbose, lactose, soluble starch, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-glucitol, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride (delayed and weak), cadaverine dihydrochloride (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrate is not assimilated. Maximum growth temperature is 25 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *De. pseudoboekhoutii* differs from the closely related species *De. boekhoutii* in its inability to assimilate soluble starch and grow in vitamin-free medium and its ability to assimilate D-arabinose and D-ribose (Table S1.11).

**Typus:** China, Fuzhou county, Fujian province, obtained from a leaf of an unidentified plant, Aug. 2011, Q.-M. Wang (*holotype* CGMCC 2.4436T preserved in a metabolically inactive state, ex-type CBS 12493 = FJYZ12-8).

**Derxomyces polymorphus** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828771. Fig. 9C, D.

*Etymology:* the specific epithet *polymorphus* refers to the variable vegetative cell morphology of the type strain.
Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ovoid fusiform, 2.0–4.8 × 4.7–8.0 μm and single, budding is polar (Fig. 9C), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-cream, smooth and dull. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are subgloboidal to napiform, 3.0–4.3 × 4.3–5.7 μm (Fig. 9D).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, inulin (weak), soluble starch, D-xyllose, L-rhamnose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine (weak), erythritol, galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin (weak) and succinate are assimilated as sole carbon sources. L-sorbitose, lactose, L-arabinose, D-arabinose, D-ribose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-mannitol, Methyl-α-D-glucoside, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak), L-lysine, ethylamine hydrochloride, cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 27–28 °C. Growth in vitamin-free medium is weak. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. polymorphus differs from the closely related species De. nakasei in its inability to assimilate L-sorbose, ribitol and sodium nitrite and its ability to assimilate erythritol (Table S1.11).

Typos: China. Xingshan county, Hubei province, obtained from a leaf of an unidentified plant, Jul. 2003, Q.-M. Wang (holotype CGMCC 2.2459T preserved in a metabolically inactive state, ex-type CBS 15445 = FJY12-13).

Dexomyces pseudoyunnanensis Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828773. Fig. 9G, H.

Etymology: the specific epithet pseudoyunnanensis refers to the similar colony morphology to that of Dexomyces yunnanensis.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 1.5–4.3 × 5.7–10.0 μm and single, budding is polar (Fig. 9G), a sediment is formed. After 1 mo at 17 °C, a pellicle and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are globose and subgloboidal to napiform, 3.6–4.4 × 3.6–5.1 μm (Fig. 9H).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, L-sorbose (variable), sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, inulin, soluble starch (variable), D-xyllose, L-arabinose (variable), D-arabinose, D-ribose (variable), D-glucosamine (variable), L-lysine, ethylamine hydrochloride, cadaverine dihydrochloride are assimilated as sole carbon sources. L-sorbitose, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-glucitol, Methyl-α-D-glucoside (variable), salicin (variable) and myo-inositol (weak) are assimilated as sole carbon sources. Lactose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, D-glucitol, succinate, citrate and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (variable), L-lysine, ethylamine hydrochloride, cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. xingshanicus differs from the closely related species De. cylindricus in its inability to assimilate L-sorbose, ribitol and sodium nitrite and its ability to assimilate erythritol (Table S1.11).
after 1 mo at 17 °C, the streak culture is yellowish-cream, butyrous, dull. The margin is entire or eroded. In Dalmau plate culture on corn meal agar, pseudohyphae and hyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are globosoidal to napiform, 2.9 × 4.8–6.5 μm (Fig. 9J).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose (delayed and weak), trehalose, melibiose, raffinose, melezitose, inulin, soluble starch, D-xylene, L-arabinose, D-arabinose, L-rhamnose (delayed and weak), salicin (delayed and weak) and myo-inositol (weak) are assimilated as sole carbon sources. L-arabinose, lactose, D-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-D-glucoside, DL-lactate, succinate, citrate and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride, cadaverine dihydrochloride are not assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. longiovatus and its closely related species De. pseudoyunnanensis as well as De. yunnanensis are very similar. The two new species are not distinguishable, they differ from De. yunnanensis in its ability to assimilate inulin (Table S1.11).

Typus: China, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3535™ preserved in a metabolically inactive state, ex-type CBS 15659 = SM35.4).

**Dexromyces napiformis** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov.

Physiologically, De. napiformis differs from its closely related species De. bifurcus in its inability to assimilate inulin, D-ribose and potassium nitrate and its ability to assimilate Methyl-α-D-glucoside, succinate and myo-inositol (Table S1.11).

**Typus**: China, Taiwan province, obtained from a leaf of an unidentified plant, Aug. 2009, Q.-M. Wang (holotype CGMCC 2.4446™ preserved in a metabolically inactive state, ex-type CBS 15748 = TW1.1F028).

**Dexromyces bifurcus** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov.

Physiologically, De. bifurcus refers to the vegetative cells producing bifurcate budding of the type strain.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are cylindrical and ellipsoidal, 1.5–2.8 × 5.0–8.3 μm and single, budding is bifurcate or multi-polar (Fig. 9M), a sediment is formed. After 1 mo at 17 °C, the streak culture is yellowish-cream, butyrous, wrinkled and dull. The margin is entire or eroded. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal to napiform, 3.0–4.0 × 5.0–6.6 μm (Fig. 9N).

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, inulin, soluble starch (weak), D-xylene, L-arabinose, D-arabinose, D-ribose and L-rhamnose are assimilated as sole carbon sources. L-arabinose, lactose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-D-glucoside, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. bifurcus differs from its closely related species De. napiformis in its inability to assimilate Methyl-α-D-glucoside, succinate and myo-inositol and its ability to assimilate inulin, D-ribose and potassium nitrate (Table S1.11).

**Typus**: China, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3470™ preserved in a metabolically inactive state, ex-type CBS 15489 = SM37.5).

**Dexromyces elongatus** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov.

Physiologically, De. elongatus differs from its closely related species De. napiformis and De. bifurcus in its inability to assimilate Methyl-α-D-glucoside, succinate and myo-inositol and its ability to assimilate inulin, D-ribose and potassium nitrate (Table S1.11).

**Typus**: China, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3470™ preserved in a metabolically inactive state, ex-type CBS 15489 = SM37.5).

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, inulin, soluble starch (weak), D-xylene, L-arabinose, D-arabinose, D-ribose and L-rhamnose are assimilated as sole carbon sources. L-arabinose, lactose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-D-glucoside, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. bifurcus differs from its closely related species De. elongatus in its inability to assimilate inulin, D-ribose and potassium nitrate (Table S1.11).

**Typus**: China, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3470™ preserved in a metabolically inactive state, ex-type CBS 15489 = SM37.5).

**Etymology**: the specific epithet *bifurcus* refers to the vegetative cells producing bifurcate budding of the type strain.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are cylindrical and ellipsoidal, 3.1–6.0 × 6.1–16.7 μm and single, budding is bifurcate or multi-polar (Fig. 9O), a sediment is formed. After 1 mo at 17 °C, the streak culture is cream, butyrous, slightly wrinkled and dull. The margin is entire. In Dalmau plate culture...
on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are globose and subglobose to naporiform, 3.3–4.0 × 3.3–5.1 μm (Fig. 9P).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, inulin, soluble starch (delayed), D-xylene, L-arabinose, D-arabinobiose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, ethanol, glycerol (delayed and weak), galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, succinate and citrate are assimilated as sole carbon sources. L-sorbitose, lactose, melezitose, ethanol, ribitol, salicin, DL-lactate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, ethylamine and cadaverine are assimilated as sole nitrogen sources. Sodium nitrate is not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. elongatus differs from the closely related species De. wuzhishanensis in its inability to grow in vitamin-free medium and its ability to assimilate D-glucosamine, D-mannitol, citrate, potassium nitrate, ethylamine and cadaverine (Table S1.11).

Typus: China, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3561T preserved in a metabolically inactive state, ex-type CBS 15498 = SM32.1).

Derxomyces melastomatis Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828778. Fig. 10A, B.

Etymology: the specific epithet melastomatis refers to Melastoma, the plant genus from which the type strain was isolated.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 2.3–4.0 × 4.7–8.2 μm and single, budding is polar (Fig. 10A), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale-yellow, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are are ellipsoidal to napiform, 2.9–4.3 × 3.0–4.3 μm (Fig. 10D).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, L-sorbose (delayed and weak), sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, D-xylene, L-arabinose, D-arabinobiose (delayed and weak), L-ribose (delayed and weak), D-ribose (delayed and weak), L-rhamnose, ribitol (delayed and weak), galactitol (delayed and weak), D-mannitol, D-glucitol (delayed and weak), Methyl-α-D-glucoside, salicin (delayed and weak) and succinate are assimilated as sole carbon sources. Lactose, inulin, soluble starch, D-glucosamine, methanol, ethanol, glycerol, erythritol, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and L-lysine are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. melastomatis differs from the closely related species De. komagatae, De. schimicola and De. pseudoschimicola in its ability to assimilate inulin (Table S1.11).

Typus: China, Wuzhishan mountain, Hainan province, obtained from a leaf Melastoma candidum, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3459T preserved in a metabolically inactive state, ex-type CBS 15465 = WZ319.7).

Derxomyces taiwanicus Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828779. Fig. 10C, D.

Etymology: the specific epithet taiwanicus refers to the geographic origin of the type strain, Taiwan.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 3.0–3.7 × 4.4–8.2 μm and single, budding is polar (Fig. 10C), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale-yellow, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are are ellipsoidal to napiform, 2.9–4.3 × 3.0–4.3 μm (Fig. 10D).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose, L-sorbose (delayed and weak), sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, D-xylene, L-arabinose, D-arabinose (delayed and weak), D-ribose (delayed and weak), L-rhamnose, ribitol (delayed and weak), galactitol (delayed and weak), D-mannitol, D-glucitol (delayed and weak), Methyl-α-D-glucoside, salicin (delayed and weak) and succinate are assimilated as sole carbon sources. Lactose, inulin, soluble starch, D-glucosamine, methanol, ethanol, glycerol, erythritol, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and L-lysine are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, De. taiwanicus differs from the closely related species De. ovatus in its inability to assimilate myo-inositol (Table S1.11).

Typus: China, Taiwan province, obtained from a leaf of an unidentified plant, Aug. 2009, Q.-M. Wang (holotype CGMCC 2.4429T preserved in a metabolically inactive state, ex-type CBS 12490 = TW3.1C-02).
**Derxomyces ovatus** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828780. Fig. 10E, F.

*Etymology:* the specific epithet *ovatus* refers to the ovoid vegetative cells of the type strain.

*Culture characteristics:* In YM broth, after 7 d at 17 °C, cells are ovoid or ellipsoidal, 2.0–5.4 × 3.8–7.7 μm and single, budding is polar (Fig. 10E), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellow, butyrous, smooth and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal to napiform, 1.8–3.6 × 3.0–4.5 μm (Fig. 10F).

*Physiological and biochemical characteristics:* Glucose fermentation is absent. Glucose, galactose, L-sorbitose (delayed and weak), sucrose, maltose, cellubiose, trehalose, melibiose, raffinose, melezitose, inulin (delayed and weak), soluble starch (weak), D-xylene, L-arabinose, L-rhamnose, ethanol (delayed and weak), galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin (delayed and weak), succinate and myo-inositol are assimilated as sole carbon sources. Lactose, D-arabinose, D-ribose, D-glucosamine, N-Acetyl-D-glucosamine, mehanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *De. longicylindricus* differs from the closely related species *De. linziensis* in its inability to assimilate D-arabinose, galactitol, D-mannitol and cadaverine and its ability to assimilate L-rhamnose, L-lysine and ethylamine (Table S1.11).

**Typus:** China, Beibeng county, Motuo, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (*holotype* CGMCC 2.5660 preserved in a metabolically inactive state, ex-type CBS 13979 = XZ132E37A).

**Phaeotremella lactea** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828782. Fig. 10I.

*Etymology:* the specific epithet *lactea* refers to the colony colour of this species.

*Culture characteristics:* In YM broth, after 7 d at 17 °C, cells are ellipsoidal, 2.7–4.0 × 4.4–6.6 μm and single, budding is polar (Fig. 10I), a sediment is present. After 1 mo at 17 °C, a pellicle and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

*Physiological and biochemical characteristics:* Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellubiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, ribitol, D-mannitol, D-glucitol, salicin, D-glucanote, succinate and myo-inositol are assimilated as sole carbon sources. L-sorbose, soluble starch, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Pha. lactea* differs from the closely related species *Pha. ovata* in its inability to assimilate soluble starch, N-Acetyl-D-glucosamine, galactitol, Methyl-α-D-glucoside and cadaverine and its ability to assimilate raffinose, succinate and myo-inositol (Table S1.12).

**Typus:** China, Milin county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (*holotype* CGMCC 2.5810 preserved in a metabolically inactive state, ex-type CBS 15574 = GPS20.4A1B).

**Phaeotremella ovata** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828783. Fig. 10J.
**Etyymology:** the specific epithet *ovata* refers to the ovoid vegetative cells of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and fusiform, 2.0–3.4 × 4.8–8.2 μm and single, budding is polar (Fig. 10J), a sediment is formed. After 1 mo at 17 °C, a pellicle and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellow, butyrous, smooth. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose (variable), melibiose, raffinose, melezitose and soluble starch, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin, DL-lactate (variable), succinate (weak), citrate (variable) and myo-inositol are assimilated as sole carbon sources. L-sorbitol, inulin, D-glucosamine, methanol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine and cadaverine dihydrochloride (variable) are assimilated as sole nitrogen sources. Sodium nitrite and ethylamine hydrochloride are not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ho. saccardoi* differs from its closely related species *Ho. coniformis* in its inability to assimilate L-sorbitol and its ability to assimilate melibiose, raffinose, erythritol and potassium nitrate (Table S1.13).

**Typus:** *China*, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (*holotype* CGMCC 2.3445T preserved in a metabolically inactive state, ex-type CBS 15479 = SM37.10).

**Holtermannia gelidoterrea** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828785. Fig. 10M.

**Etyymology:** the specific epithet *gelidoterrea* refers to the cold environments origin of all strains used in this study.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and ovoid, 3.3–4.8 × 4.1–5.5 μm and single, budding is polar (Fig. 10M), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glis
tening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbitol, sucrose, maltose, cellobiose, trehalose, lactose (variable), melibiose, raffinose, melezitose, soluble starch, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin, DL-lactate (variable), succinate (weak), citrate (variable) and myo-inositol are assimilated as sole carbon sources. L-sorbitol, inulin, D-glucosamine, methanol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite and ethylamine hydrochloride are not assimilated. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Typus:** *China*, Simao county, Yunnan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (*holotype* CGMCC 2.3445T preserved in a metabolically inactive state, ex-type CBS 15479 = SM37.10).

**Holtermannia saccardoi** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828785. Fig. 10K, L.
Physiologically, *So. gelidoterea* differs from its four closely related species, *So. aenula, So. terreata, So. phenolica* and *So. fuscescens*, in its inability to assimilate succinate and its ability to assimilate inulin (Table S1.14).

**Typus: China,** Daxinganling, obtained from soil, Aug. 2015, Q.-M. Wang (**holotype** CGMCC 2.5814\(^1\) preserved in a metabolically inactive state, ex-type CBS 15580 = HFB003-3).

*Filobasidium dingjieense* Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.** MycoBank MB828786. Fig. 10N.

**Etymology:** the specific epithet *dingjieense* refers to the geographic origin of the type strain, Dingjie county, Tibet.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosil and ellipsoidal, 6.8–10.6 × 6.9–10.6 μm and single, budding is polar (Fig. 10P), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is gray-cream, mucoid, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin, D-xylose (delayed and weak), L-arabinose, L-rhamnose (delayed and weak), D-mannitol, Methyl-α-D-glucoside (weak), succinate (weak) and myo-inositol (weak) are assimilated as sole carbon sources. L-sorbitol, soluble starch, D-arabinose, D-ribose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-glucitol, salicin, DL-lactate, citrate and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is positive. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *F. mali* differs from its closely related species *F. mali* in its inability to assimilate ribitol, galactitol, salicin and ethylamine and its ability to assimilate lactose and grow in vitamin-free medium (Table S1.15).

**Typus: China,** Yichun county, Heilongjiang province, obtained from a leaf of an unidentified plant, Aug. 2014, Q.-M. Wang (**holotype** CGMCC 2.5860\(^1\) preserved in a metabolically inactive state, ex-type CBS 15658 = HLJ8A3).

*Filobasidium mali* Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.** MycoBank MB828789. Figs 10P and 11A.

**Etymology:** the specific epithet *mali* refers to the substrate origin of the type strain, *Malus*.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosil and ellipsoidal, 3.0–4.6 × 3.0–7.7 μm and single, budding is polar (Fig. 10P), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is gray-cream, mucoid, smooth and shiny. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, inulin, D-xylose (delayed and weak), L-arabinose, L-rhamnose (delayed and weak), D-mannitol, Methyl-α-D-glucoside (weak), succinate (weak) and myo-inositol (weak) are assimilated as sole carbon sources. L-sorbitol, soluble starch, D-arabinose, D-ribose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-glucitol, salicin, DL-lactate, citrate and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite and ethylamine hydrochloride (variable) are assimilated. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is negative.
Fig. 11. SEM image of vegetative cells grown in YM broth for 5 d at 17 °C. (A) 
*Fl. mali* CGMCC 2.4012T, Bars = 4 μm; (B) *Boe. sterigmata* CGMCC 2.4539T, Bars = 5 μm; (C) 
*St. layueensis* CGMCC 2.5817T, Bars = 5 μm; (D) *Pse. motuoensis* CGMCC 2.5816T, Bars = 2 μm; (E) *Me. layueensis* CGMCC 2.5818T, Bars = 5 μm; (F) *Beg. foliicola* CGMCC 
2.3164T, Bars = 1 μm; (G, H) *Ros. petaloides* CGMCC 2.3446T, G Bars = 10 μm, H Bars = 3 μm.
Starch-like substances are produced or not. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Fi. mali* differs from its closely related species *Fi. globosum* in its inability to grow in vitamin-free medium and its ability to assimilate ribitol, galactitol and salicin (Table S1.15).

**Typus: China**, Tai’an county, Shandong province, obtained from isolated from apple, Aug. 2008, Q.-M. Wang (*holotype* CGMCC 2.4012\(^{T}\) preserved in a metabolically inactive state, ex-type CBS 15651 = KTAPG4-11.64).

*Filobasidium mucilaginum* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov*. MycoBank MB828790. Fig. 12A.

**Etymology:** the specific epithet *mucilaginum* refers to the mucoid colony morphology of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are subglobosal and ellipsoidal, 3.8–8.1 × 3.8–8.8 μm and single, budding is polar (Fig. 12A), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is grey-cream, mucoid, smooth and shiny. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, D-xylene (delayed and weak), L-arabinose, D-ribose, ethanol, glycerol, erythritol, ribitol (delayed and weak), galactitol (delayed and weak), D-mannitol, D-glucitol, Methyl-α-D-glucoside (delayed and weak), salicin (delayed and weak), D-lactate and succinate are assimilated as sole carbon sources. L-sorbose, inulin, soluble starch, D-arabinose, L-rhamnose, D-glucosamine, succinate are assimilated as sole carbon sources. L-sorbose, inulin, soluble starch, L-arabinose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 23 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced or not. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Pha. aurantiaca* differs from its closely related species *Pha. rhodozyma* in its inability to assimilate soluble starch and its ability to assimilate galactose, lactose, melezitose, erythritol and ethylamine (Table S1.16).

**Typus: China**, Lulang county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (*holotype* CGMCC 2.5601\(^{T}\) preserved in a metabolically inactive state, ex-type CBS 15548 = GPS23.2A4).

**New taxa in Agaricostilbomycetes (Pucciniomycotina)**

*Konoda cylindrica* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov*. MycoBank MB828792. Fig. 12C, D.

**Etymology:** the specific epithet *cylindrica* refers to the cylindrical ballistoconidia of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 3.4–6.4 × 5.2–8.9 μm and single, budding is polar (Fig. 12C), a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is orange, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose, melibiose, raffinose, melezitose, D-xylene (delayed and weak), L-arabinose, D-ribose, ethanol, glycerol, erythritol, ribitol (delayed and weak), galactitol (delayed and weak), D-mannitol, D-glucitol, Methyl-α-D-glucoside (delayed and weak), salicin (delayed and weak), D-lactate and succinate are assimilated as sole carbon sources. L-sorbose, inulin, soluble starch, D-arabinose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrite are not assimilated. Maximum growth temperature is 23 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced or not. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Pha. aurantiaca* differs from its closely related species *Pha. rhodozyma* in its inability to assimilate soluble starch and its ability to assimilate galactose, lactose, melezitose, erythritol and ethylamine (Table S1.16).

**Typus: China**, Lulang county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (*holotype* CGMCC 2.5601\(^{T}\) preserved in a metabolically inactive state, ex-type CBS 15548 = GPS23.2A4).

**New taxa in Agaricostilbomycetes (Pucciniomycotina)**

*Konoda cylindrica* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov*. MycoBank MB828792. Fig. 12C, D.

**Etymology:** the specific epithet *cylindrica* refers to the cylindrical ballistoconidia of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 2.4–4.8 × 4.8–8.5 μm and single, budding is polar (Fig. 12C), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale orange, butyrous, smooth and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are cylindrical, 2.1–2.9 × 4.3–5.7 μm (Fig. 12D).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, cellobiose (variable), trehalose, raffinose (variable), melezitose (variable), soluble starch, D-xylene (variable), L-arabinose (variable), D-
ribose (variable), L-rhamnose, ethanol (variable), glycerol, erythritol (variable), ribitol (variable), galactitol (variable), D-mannitol, D-glucitol, Methyl-α-D-glucoside (variable), salicin (variable), succinate (delayed and weak) and citrate (variable) are assimilated as sole carbon sources. Galactose, L-sorbitose, lactose, melibiose, inulin, D-arabinose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, D-gluconate, DL-lactate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate and sodium nitrite (variable) and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not formed. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Kon. cylindrica differs from its closely related species Kon. aeria and Kon. malvinella in its inability to assimilate DL-lactate and its ability to grow in vitamin-free medium (Table S1.17).

**Typus**: Germany, obtained from a leaf of an unidentified plant, Sep. 2005 (**holotype** CGMCC 2.3102^T^ preserved in a metabolically inactive state, ex-type CBS 15466 = G6.1-1).  
**Kondoa chamaenerii** Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.**  
MycoBank MB828793. Fig. 12E, F.

**Etymology**: The specific epithet **chamaenerii** refers to Chamaenerion, the plant genus from which the type strain was isolated.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are cylindrical, 2.6–4.3 × 5.7–10.0 μm and single, budding is polar (Fig. 12E), a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is pinkish-cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are long ellipsoidal, 2.9–4.3 × 7.1–10.0 μm (Fig. 12F).

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, galactose (variable), L-sorbitose (variable), sucrose, maltose, melibiose, trehalose, lactose (variable), raffinose (variable), inulin (weak), soluble starch (variable), glycerol, ribitol (delayed and weak), mandinit (delayed and weak) and D-glucitol (variable) are assimilated as sole carbon sources. Melibiose, melezitose, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, methanol, ethanol, erythritol, galactitol, D-Methyl-α-D-glucoside, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and potassium nitrate (weak), L-lysine and ethylamine hydrochloride (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrite and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Kon. foliicola differs from its closely related species Kon. arboricola in its inability to assimilate maltose, grow in vitamin-free medium and produce starch like compounds and its ability to assimilate melanitose, D-arabinose and D-glucosamine (Table S1.17).

**Typus**: Germany, obtained from a leaf of an unidentified plant, Sep. 2005 (**holotype** CGMCC 2.3103^T^ preserved in a metabolically inactive state, ex-type CBS 15465 = G9.1).  
**Kondoa foliicola** Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.**  
MycoBank MB828794. Fig. 12G, H.

**Etymology**: The specific epithet **foliicola** refers to the substrate origin of the type strain, leaves.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are ellipsoidal and somewhat ovoid, 3.1–5.4 × 5.1–7.8 μm and single, budding is polar (Fig. 12G), a sediment is formed. After 1 mo at 17 °C, an incomplete ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale-yellow, butyrous, dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal or ovoid, 2.5–4.0 × 3.8–8.8 μm (Fig. 12H).

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, sucrose, cellobiose, trehalose, lactose, raffinose, melezitose, soluble starch, D-xylene, L-arabinose, D-arabinose, glucosamine, glycerol, ribitol and D-mannitol are assimilated as sole carbon sources. Galactose, L-sorbitose, maltose, melibiose, inulin, D-ribose, L-rhamnose, D-N-methanol, ethanol, erythritol, galactitol, D-glucitol, Methyl-D-glucoside, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak), L-lysine and ethylamine hydrochloride (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrite and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Kon. subrosea differs from its closely related species Kon. arboricola in its inability to assimilate maltose, grow in vitamin-free medium and produce starch like compounds and its ability to assimilate melezitose, D-arabinose and D-glucosamine (Table S1.17).

**Typus**: Germany, obtained from a leaf of an unidentified plant, Sep. 2005 (**holotype** CGMCC 2.3100^T^ preserved in a metabolically inactive state, ex-type CBS 15465 = G9.1).  
**Kondoa subrosea** Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.**  
MycoBank MB828795. Fig. 12I, J.

**Etymology**: The specific epithet **subrosea** refers to the substrate origin of the type strain, tree.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are ellipsoidal, 2.9–5.0 × 7.1–10.0 μm and single, budding is polar (Fig. 12I), a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish cream, butyrous, smooth and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 3.0–5.7 × 7.0–15.7 μm (Fig. 12J).

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, L-sorbitose (variable), sucrose (variable), maltose, melibiose, trehalose, lactose (variable), raffinose, inulin (variable), soluble starch (variable), D-xylene (variable), L-arabinose (variable), ethanol (variable), glycerol, ribitol (variable), D-mannitol (variable), D-glucitol (variable), DL-lactate (variable) and succinate (variable) are assimilated as sole carbon sources. Galactose, melibiose, melezitose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, methanol,
erythritol, galactitol, Methyl-α-D-glucoside, salicin, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak), L-lysine (weak) and ethylamine hydrochloride are assimilated as sole nitrogen sources. Sodium nitrite and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Kon. arboricola* differs from its closely related species *Kon. foliicola* in its inability to assimilate melezitose, D-arabinose and D-glucosamine and its ability to assimilate maltose, grow in vitamin-free medium and produce starch like compounds (Table S1.17).

**Typus: China,** Bomi county, Tibet, obtained from a leaf of tree, Sep. 2004, F.-Y. Bai (holotype CGMCC 2.2621T preserved in a metabolically inactive state, ex-type CBS 15452 = XZ12B5).

*Konoda lulangica* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828796. Fig. 12K, L.

**Etymology:** the specific epithet *lulangica* refers to the geographic origin of the type strain, Lulang county, Tibet.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 2.4–3.8 × 5.0–7.6 μm and single, budding is polar (Fig. 12K), a sediment is formed. After 1 mo at 17 °C, a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is pale pink, butyrous, smooth and glistening. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.6–2.9 × 5.7–8.6 μm (Fig. 12L).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose (delayed), maltose, trehalose, delayed and weak, melezitose, D-glucosamine, N-acetyl-D-glucosamine, methanol, erythritol, maltose, trehalose, melezitose, L-arabinose (variable), ethanol (variable), glycerol, ribitol (variable), D-mannitol (variable), D-glucitol (variable), salicin (variable) and DL-lactate (variable) are assimilated as sole carbon sources. Galactose, L-sorbosone, lactose, melibiose, raffinose, inulin, soluble starch, D-xylose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, methanol, ethylalcohol, ribitol, galactitol, salicin, DL-lactate, succinate, nitrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride (weak) and cadaverine dihydrochloride (weak) are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 22–23 °C. Growth in vitamin-free medium is variable. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Kon. daliangziensis* and *Kon. ribitophobia* are difficult to distinguish from each other. The latter can grow at 25 °C, but the former does not. *Kon. daliangziensis* differs from *Kon. gutianensis* in its inability to assimilate galactose and inulin and its ability to assimilate L-lysine (Table S1.17).

**Typus: China,** Daliangzi river national forest park, Heilongjiang province, obtained from a leaf of an unidentified plant, Aug. 2014, Q.-M. Wang (holotype CGMCC 2.5610T preserved in a metabolically inactive state, ex-type CBS 13974 = HLJ22A8).

*Konoda ribitophobia* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828798. Fig. 12O.

**Etymology:** the specific epithet *ribitophobia* refers to the physiological character of not assimilating ribitol.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are globosal, oval and ellipsoidal, 3.3–4.9 × 4.5–8.3 μm and single, budding is polar (Fig. 12O), a sediment is formed. After 1 mo at 17 °C, a pellicle and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale yellow, butyrous, smooth and glossy. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose (variable), L-sorbose (variable), sucrose, maltose, cellobiose (variable), trehalose, melezitose, inulin (variable), L-arabinose (variable), L-rhamnose (variable), ethanol (variable), glycerol, D-mannitol (delayed and weak), D-glucitol (variable), Methyl-α-D-glucoside (variable), salicin (weak) and succinate (variable) are assimilated as sole carbon sources. Lactose, melibiose, raffinose, soluble starch, D-
xylose, D-arabinose, D-ribose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, erythritol, ribitol, galactitol, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak), L-lysine (variable), ethylamine hydrochloride (variable) and cadaverine dihydrochloride (variable) are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is variable. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Kon. ribitophobia* differs from its closely related species *Kon. gutianensis* in its inability to assimilate ribitol (Table S1.17).

**Typus:** China, Taiwan province, obtained from a leaf of an unidentified plant, Aug. 2009, Q.-M. Wang (holotype CGMCC 2.4441\(^T\) preserved in a metabolically inactive state, ex-type CBS 12496 = TW2.1E-016).

*Kon. myxariophila* J.P. Sampaio, Q.M. Wang & F.Y. Bai sp. nov. MycoBank MB828799. Figs 12P and 13.

**Etymology:** the specific epithet *myxariophila* refers to the association of the novel taxon with the fruiting bodies of *Myxarium nucleatum* (Auriculariales).

**Sexual characteristics:** The sexual stage is observed PDA and MYP plates incubated at 20 °C for 8–12 wk and occurs in individual strains in the absence of mating. Hyphae are 3–5 μm in diameter and have clamp connections. Basidia are cylindrical, transversely-septate, usually four-celled and measure 40–60 × 7.5–5 μm (Fig. 13A, C). Basidiospores are formed at the end of basidial sterigmata, measuring 10–5 μm in length. Basidiospores are oval, measure 11–9 × 7–5 μm (Fig. 13B), are forcefully ejected (ballistospores) and germinate by budding. Haustorial branches are conspicuously formed and occur laterally on hyphae (Fig. 13C, D).

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal to ovoid, measure 3–4 × 4–6 μm and occur single or in pairs and budding is polar (Fig. 12P). A sediment is formed. After 1 mo at 17 °C, a pellicle and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale yellow, butyrous, semi-glossy and smooth. The margin is entire. In Dalmau plate culture on corn meal agar, pseudo-hyphae are not formed. Ballistoconidia can be produced in solid medium (CMA) but are rare and measure 4–5 × 5–8 μm (Fig. 13E).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, trehalose, melibiose (variable), celllobiose (variable), raffinose (variable), melezitose, soluble starch, D-xylose, L-arabinose (delayed and weak), D-arabinose (delayed and weak), D-ribose (variable), L-rhamnose (delayed and weak), D-glucosamine (variable), glycerol (delayed and weak), ribitol (variable), salicin (variable), D-mannitol (delayed and weak), D-glucitol (delayed and weak), succinate (delayed and weak) and citrate (weak) are assimilated as sole carbon sources. Galactose, L-sorbose, lactose, inulin, methanol, ethanol, erythritol, galactitol, Methyl-α-D-glucoside, DL-lactate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (variable), sodium nitrite (variable), ethylamine hydrochloride (delayed and weak) and cadaverine dihydrochloride (delayed and weak) are assimilated as sole nitrogen sources. L-lysine is not assimilated. Maximum growth temperature is 22–25 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Kon. myxariophila* differs from its closest relatives, *Kon. daliangziensis*, *Kon. ribitolophobia* and *Kon. gutianensis*, in its inability to assimilate L-lysine and its ability to assimilate soluble starch and D-xylose (Table S1.17).

**Typus:** Portugal, Sesimbra, obtained from the fruiting body of *Myxarium nucleatum* (Auriculariales), Nov. 1992, J.P. Sampaio

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**Fig. 13.** Vegetative cells, ballistoconidia and the sexual stage of *Kon. myxariophila* CBS 8379\(^\text{T}\). (A) Basidia; (B) Basidiospores; (C, D) Haustorial branches; (E) Ballistoconidia. Bars = 10 μm.
(holotype PYCC 5509\(^\text{T}\) preserved in a metabolically inactive state, ex-type CBS 8379 = ZP 337).  

**Note:** Besides several sexual strains isolated with the balliocoloidium-aal method from basidioecarps of *Myxarium nucleatum* in Portugal (PYCC 5509 = ZP 337; PYCC 8354 = ZP 338; and PYCC 8305 = ZP 352) in 1992 and 1996, another strain was isolated from the leaf of an unidentified plant, collected in Germany in September 2005 (CGMCC 2.3106 = CBS 15468).

Although a sexual stage has not been reported for the culture isolated in Germany, these four strains have similar ITS sequences. Therefore, *K. myxariophila* appears to be capable to engage in mycoparasitism because it produces haustorial branches and is ecologically associated with other fungi. Nevertheless, the mycoparasitic strategy might be combined with a saprobe lifestyle in the phylloplane since *K. myxariophila* is also able to produce ballistoconidia and is also found in association with plant leafs. Similarly to the other two sexual species in the genus, *K. aera* and *K. malvinella*, *K. myxariophila* does not produce teliospores, produces transversely-septate basidia and its basidiospores are forcefully discharged (ballistospores).

**Kondo rhododendri** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828800. Fig. 14A, B.

**Etymology:** the specific epithet *rhododendri* refers to *Rhododendron*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid, ellipsoidal and cylindrical, 2.7–4.8 × 4.5–9.5 μm and single, budding is polar (Fig. 14A), a sediment is formed. After 1 mo at 17 °C, a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is pinkish cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are cylindrical, 2.9–3.7 × 7.4–10.0 μm (Fig. 14D).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellulbiose, trehalose, lactose (delayed and weak), melibiose, raffinose, melezitose, soluble starch, D-xylose, L-arabinose (delayed and weak), D-ribbose, L-rhamnose (weak), D-glucosamine (delayed and weak), ethanol, glycerol (weak), erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin, DL-lactate, succinate (delayed and weak) and citrate (weak) are assimilated as sole carbon sources. L-sorbose, inulin, methanol, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, sodium nitrate (delayed and weak), L-lysine, ethylamine hydrochloride (delayed and weak) and cadaverine dihydrochloride (delayed and weak) are assimilated as sole nitrogen sources. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/v) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *B. wuzhishanensis* differs from its closely related species, *Be. pseudorectispora*, *Be. bomiensis*, *Be. naganoensis*, *Be. pseudonaganoensis* and *Be. rectispora*, in its ability to assimilate D-ribose, ethanol and erythritol (Table S1.16).

**Typus: China**, Wuzhishan mountain, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3569\(^\text{T}\) preserved in a metabolically inactive state, ex-type CBS 15661 = WZS33.18).

**Bensingtonia pseudorectispora** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828802. Fig. 14E.

**Etymology:** the specific epithet *pseudorectispora* refers to the similar colony morphology to that of *Bensingtonia rectispora*.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 2.8–3.2 × 7.2–10.3 μm and single, budding is polar (Fig. 14E), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pink red, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, maltose, melezitose, D-mannitol and salicin are assimilated as sole carbon sources. Galactose, L-sorbose, sucrose, cellulbiose, trehalose, lactose, melibiose, raffinose, inulin, soluble starch, D-xylose, L-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-
glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-glucitol, Methyl-α-D-glucoside, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 22–23 °C. Growth in vitamin-free medium negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive. Physiologically, *Be. pseudorectispora* differs from its closely related species *Be. rectispora* in its inability to assimilate sucrose, trehalose and glycerol and its ability to assimilate salicin and ethylamine (Table S1.18).

Typus: **China**, Bomi, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CGMCC 2.5677T preserved in a metabolically inactive state, ex-type CBS 15750 = XZ154D5).

**Pseudobensingtonia fusiformis** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828803. Fig. 14F.

**Etymology:** the specific epithet *fusiformis* refers to the fusiform vegetative cells of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical, ellipsoidal and fusiform, 7.6–13.3 × 2.2–3.6 μm and single, budding is polar (Fig. 14F), a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is yellow, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, L-sorbosone, sucrose, cellobiose, trehalose, lactose, raffinose, inulin, D-xyllose, L-arabinose (variable), D-ribose (weak), ethanol (variable), glycerol, erythritol, ribitol, D-mannitol, D-glucitol, D-gluconate and succinate are assimilated as sole carbon sources. Galactose, maltose, melibiose, melezitose, soluble starch, D-arabinose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, galactitol, D-glucitol, Methyl-α-D-glucoside, salicin, D-glucurate, D-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrate and L-lysine are not assimilated. Maximum growth temperature is 21 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ru. fanjingshanensis* differs from its closely related species *Ru. dracophyllii* in its inability to assimilate L-sorbose, sucrose, maltose, cellobiose, melezitose, glycerol, ribitol, galactitol, D-mannitol, D-glucitol, salicin and succinate and its ability to assimilate trehalose, inulin, ethylamine and cadaverine (Table S1.20).

Typus: **China**, Fanjingshan Mountain, Guizhou province, obtained from a leaf of an unidentified plant, Oct. 2011, Q.-M. Wang (holotype CGMCC 2.4542T preserved in a metabolically inactive state, ex-type CBS 15745 = FJS6C7).

**Ruinenia bangxiensis** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828805. Fig. 14I, J.

**Etymology:** the specific epithet *bangxiensis* refers to the geographic origin of the type strain, Bangxi county, Hainan.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 2.2–3.7 × 6.4–10.5 μm and single, budding is polar (Fig. 14I), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pink-red, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.1–3.6 × 5.0–7.9 μm (Fig. 14H).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, maltose, trehalose, melibiose, raffinose, inulin, soluble starch (weak), ribitol and D-mannitol are assimilated as sole carbon sources. Galactose, L-sorbose, sucrose, cellobiose, lactose, melezitose, D-xyllose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, galactitol, D-glucitol, Methyl-α-D-glucoside, salicin, D-glucurate, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrate and L-lysine are not assimilated. Maximum growth temperature is 23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ps. ingoldii* differs from its closely related species *Ps. ingoldii*, Bomi, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CGMCC 2.5823T preserved in a metabolically inactive state, ex-type CBS 15647 = XZ152EA3).

**Ruinenia fanjingshanensis** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828804. Fig. 14G, H.

**Etymology:** the specific epithet *fanjingshanensis* refers to the geographic origin of the type strain, Fanjingshan Mountain, Guizhou.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 2.1–3.6 × 5.0–7.9 μm and single, budding is polar (Fig. 14G), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pink-red, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.1–3.6 × 5.0–7.9 μm (Fig. 14H).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, maltose, trehalose, melibiose, raffinose, inulin, soluble starch (weak), ribitol and D-mannitol are assimilated as sole carbon sources. Galactose, L-sorbose, sucrose, cellobiose, lactose, melezitose, D-xyllose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, galactitol, D-glucitol, Methyl-α-D-glucoside, salicin, D-glucurate, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrate and L-lysine are not assimilated. Maximum growth temperature is 21 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ps. fusiformis* differs from its closely related species *Ps. fusiformis*, Bomi, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CGMCC 2.4542T preserved in a metabolically inactive state, ex-type CBS 15745 = FJS6C7).

**Ruinenia bangxiensis** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828805. Fig. 14I, J.

**Etymology:** the specific epithet *bangxiensis* refers to the geographic origin of the type strain, Bangxi county, Hainan.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 2.2–3.7 × 6.4–10.5 μm and single, budding is polar (Fig. 14I), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pink-red, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar.

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**Fig. 14.** Vegetative cells grown in YM broth for 5 d at 17 °C and ballistoconidia produced on corn meal agar after 7 d at 17 °C. (A, B) Kon. rhododendri CGMCC 2.3463T; (C, D) Ben. wuzhishanensis CGMCC 2.3599T; (E) Ben. pseudorectispora CGMCC 2.5677T; (F) Ps. fusiformis CGMCC 2.5823T; (G, H) Ru. fanjingshanensis CGMCC 2.4542T; (I, J) Ru. bangxiensis CGMCC 2.3454T; (K, L) Ru. junata CGMCC 2.4426T; (M, N) Boe. sternigama CGMCC 2.4539T; (O) St. layueensis CGMCC 2.5817T; (P) Pse. motuoensis CGMCC 2.5816T. Bars = 10 μm.
Ballistoconidia are allantoid or reniform, 2.4–2.9 × 5.3–7.3 μm (Fig. 14J).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, cellulobiose, trehalose, melibiose, raffinose, melezitose, inulin (variable), soluble starch (weak), D-xylose (weak), L-ribonose (delayed and weak), ethanol (variable), ribitol (variable), D-glucitol (variable), sucrose (variable), and D-mannitol are assimilated as sole carbon sources. Galactose, L-sorbose, lactose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, methyl-α-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate and L-lysine (variable) are assimilated as sole nitrogen sources. Sodium nitrite, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 25 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Diazonium Blue B reaction is positive. Urease activity is positive. Diazonium Blue B reaction is positive.

**Physiologically,** Physiologically, _Ru. bangxiensis_ differs from its closely related species _Ru. clavata_ in its inability to assimilate D-ribose and cadaverine and its ability to assimilate potassium nitrate (Table S1.20).

**Typus:** China, Bangxi county, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.34541 preserved in a metabolically inactive state, ex-type CBS 10819 = HBX1.0).

**Ruinenia lunata** Q.M. Wang, F.Y. Bai & A.H. Li _sp. nov._ MycoBank MB828806. Fig. 14K, L.

**Etymology:** the specific epithet _lunata_ refers to the falcate ballistoconidia of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal to falcate, 1.8–3.5 × 5.0–9.0 μm and single, budding is polar (Fig. 14K), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is orange-red, butyrous, smooth. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are reniform to falcate, 3.0–6.5 × 6.0–13.0 μm (Fig. 14L).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, cellulobiose (variable), trehalose, melibiose, raffinose, melezitose, ribitol (delayed), D-mannitol (delayed) and D-glucitol (delayed and weak) are assimilated as sole carbon sources. Galactose, L-sorbose, lactose, inulin, soluble starch, L-rhamnose, D-xylose, D-arabinose, D-ribose, D-glucosamine, methyl-α-D-glucoside, salicin, ethanol, erythritol, galactitol, glycerol, DL-lactic acid, citric acid, salicin, succinic acid, inositol and hexadecane are not assimilated. Ammonium sulfate and ethylamine hydrochloride (variable) are assimilated as sole nitrogen sources. L-lysine, sodium nitrite, potassium nitrate and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 22 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, _Ru. lunata_ differs from its closely related species _Ru. bangxiensis_ and _Ru. clavata_ in its inability to assimilate soluble starch and D-xylose and grow at 25 °C (Table S1.20).

**Typus:** China, Taiwan province, obtained from a leaf of an unidentified plant, Aug. 2009, Q.-M. Wang (holotype CGMCC 2.44261 preserved in a metabolically inactive state, ex-type CBS 12525 = TW 2.1E-028).

**Boekhoutia** Q.M. Wang & F.Y. Bai _gen. nov._ MycoBank MB828807.

**Etymology:** the genus is named in honour of Dr. Teun Boekhout for his research contributions to yeast taxonomy.

This genus is proposed for the branch represented by strain CGMCC 2.4539, which formed a separate clade from _Kurtzmanomyces_. Member of the Chionosphaeraceae (Agaricostilbales). The genus is mainly circumscribed by the phylogenetic analysis of the seven genes dataset, in which it occurred as a separate branch within Chionosphaeraceae (Fig. 4A).

Sexual reproduction not known. Colonies orange red, butyrous. Budding cells present and ballistoconidia produced at the end of a stalk-like conidiophore. Conidiophore single or multiple, usually multifurcate. Pseudohyphae and hyphae not produced. Ballistoconidia formed.

**Type species:** _Boekhoutia sterigmata_ Q.M. Wang, F.Y. Bai & A.H. Li

*Note: Boekhoutia* and its close relative _Kurtzmanomyces_ can produce stalk-like conidiophores, the former usually produces multifurcate conidiophores; each conidiophore of the latter can produce sequential multiple blastoconidia (Sampaio 2011b). _Boekhoutia_ does not assimilate ethanol and D-mannitol, whereas all species of _Kurtzmanomyces_ assimilate these two carbon sources.

**Boekhoutia sterigmata** Q.M. Wang, F.Y. Bai & A.H. Li _sp. nov._ MycoBank MB828808. Figs 11B and 14M, N.

**Etymology:** the specific epithet _sterigmata_ refers to the vegetative cells producing conidia on stalk-like conidiophores in the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and cylindrical, 2.8–3.2 × 7.2–10.3 μm and single, budding is polar (Fig. 14M), a sediment is present. One or more conidia are produced on each stalk-like conidiophore. Conidiophore is single or multiple, usually multifurcate. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is deep pink red, butyrous, wrinkled and dull. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.6–3.2 × 3.8–5.8 μm (Fig. 14N).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose (delayed and weak), cellulobiose, trehalose, melezitose and inulin are assimilated as sole carbon sources. L-sorbose, lactose, melibiose, raffinose, soluble starch, D-xylose, D-arabinose, D-ribose, D-glucosamine, methyl-α-D-glucoside, salicin, ethanol, erythritol, galactitol, glycerol, DL-lactic acid, citric acid, salicin, succinic acid, inositol and hexadecane are not assimilated. Ammonium sulfate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 22 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, _Boekhoutia sterigmata_ differs from its closely related species _Boekhoutia clavata_ and _Boekhoutia lunata_ in its inability to assimilate soluble starch and D-xylose and grow at 25 °C (Table S1.20).
hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Potassium nitrate and sodium nitrate are not assimilated. Maximum growth temperature is 23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Type species:** China. Fanjingshan Mountain, Guizhou province, obtained from a leaf of an unidentified plant, Oct. 2011, Q.-M. Wang (holotype CGMCC 2.4539T preserved in a metabolically inactive state, ex-type CBS 15553 = FJS3F22).

**Jianyuniaeae** Q.M. Wang & F.Y. Bai fam. nov. MycoBank MB828809.

Member of the family Jianyuniaeae is based on the the genus Jianyunia. The nomenclature of the family is based on the genus Jianyunia.

**Type genus:** Jianyunia Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout.

**Genera accepted:** Jianyunia Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, Sterigmatospora Q.M. Wang & F.Y. Bai, Pseudosterigmatospora Q.M. Wang & F.Y. Bai.

**Sterigmatospora** Q.M. Wang & F.Y. Bai gen. nov. MycoBank MB828810.

**Etymology:** the genus is named based on the morphology of the vegetative cells, which produce conidia on stalk-like conidiophores.

This genus is proposed for the branch represented by strain CGMCC 2.5817, which formed a separate clade. Member of the Jianyuniaeae (Agaricostilbales). The genus is mainly circumscribed by the phylogenetic analysis of the seven genes dataset, in which it occurred as a separate branch within Jianyuniaeae (Fig. 4A).

Sexual reproduction not known. Colonies cream, butyrous. Budding cells present and blastoconidia produced on stalk-like conidiophores. Conidiophore single or multiple, usually cluster on cells. Pseudohyphae and hyphae not produced. Ballistocinidia not formed.

**Type species:** Sterigmatospora layueensis Q.M. Wang, F.Y. Bai & A.H. Li & A.H. Li.

**Note:** Sterigmatospora and Pseudosterigmatospora can produce stalk-like conidiophores, the former usually produces cluster of conidiophores from one site on cells, the latter can form bifurcate or trifurcate conidiophores. They are also distinguished by some physiological characteristics (Table S1.21), such as assimilation of raffinose and growth in vitamin-free medium.

**Sterigmatospora layueensis** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828811. Figs 11C and 14O.

**Etymology:** the specific epithet layueensis refers to the geographic origin of the type strain, Layue county, Tibet.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 2.8–3.5 × 3.8–5.9 μm and single, budding is polar (Fig. 14O), a sediment is present. After 1 mo at 17 °C, a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is pale yellow, butyrous, smooth and glossy. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistocinidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, L-sorbose, sucrose, maltose, cellobiose, trehalose, raffinose, melezitose, D-xyllose (variable), L-arabinose (variable), ribitol (variable), D-mannitol, D-glucitol, Methyl-α-D-glucoside and salicin (variable) are assimilated as sole carbon sources. Galactose, lactose, melibiose, inulin, soluble starch, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrate is not assimilated. Maximum growth temperature is 20 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Type species:** China, Layue county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CGMCC 2.5817T preserved in a metabolically inactive state, ex-type CBS 15649 = XZ100A2B).

**Pseudosterigmatospora** Q.M. Wang & F.Y. Bai gen. nov. MycoBank MB828812.

**Etymology:** the genus is named because of a similar morphology as present in the genus Sterigmatospora.

This genus is proposed for the branch represented by strain CGMCC 2.5816, which formed a separate clade. Member of the Jianyuniaeae (Agaricostilbales). The genus is mainly circumscribed by the phylogenetic analysis of the seven genes dataset, in which it occurred as a separate branch within Jianyuniaeae (Fig. 4A).

Sexual reproduction not known. Colonies white to cream, butyrous. Budding cells present and blastoconidia produced on stalk-like conidiophores. Conidiophores single or multiple, usually bifurcate, somewhat trifurcate. Pseudohyphae and hyphae not produced. Ballistocinidia not formed.

**Type species:** Pseudosterigmatospora motuoensis Q.M. Wang, F.Y. Bai & A.H. Li & A.H. Li sp. nov. MycoBank MB832545. Figs 11D and 14P.

**Etymology:** the specific epithet motuoensis refers to the geographic origin of the type strain, Motuo, Tibet.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 2.2–3.0 × 3.7–5.3 μm and single, budding is polar (Fig. 14P), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. One or more conidia are produced on each stalk-like conidiophore. Conidiophore is single or multiple, usually bifurcate, somewhat trifurcate. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-cream, butyrous, smooth and glossy. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed.
Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose (delayed and weak), L-sorbitose (delayed and weak), sucrose, maltose (delayed and weak), trehalose, melezitose, ethanol, D-mannitol, D-glucitol and salicin (delayed and weak) are assimilated as sole carbon sources. Cellobiose, lactose, melibiose, raffinose, inulin, soluble starch, D-xylene, L-arabinose, D-ribbose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, erythritol, ribitol, galactitol, Methyl-α-D-glucoside, D-glucanate, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, sodium nitrite (delayed and weak), are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Typus:** China, Motuo, Tibet, obtained from a leaf of *Achyrospermum waliclanium*, Sep. 2014, Q.-M. Wang (*holotype* CGMCC 2.5816T; *isotype* CGMCC 2.3822T; *neo-epitype* CGMCC 2.5669T; *epitype* CGMCC 2.2662T; *neo-isotypy* CGMCC 2.5143T; *ex-type* CBS 15591 = XZ17B3).

**New taxa in Spiculogloeomycetes (Pucciniomycotina)**

**Phylozyma aceris** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828813. Fig. 15A, B.

**Etymology:** the specific epithet aceris refers to *Acer*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical, 1.6–3.5 × 5.5–8.9 μm and single, budding is polar (Fig. 15A), a sediment is present. After 1 mo at 17 °C, a pellicle and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, D-mannitol, D-glucitol (delayed), D-glucanate (weak) and DL-lactate (weak) are assimilated as sole carbon sources. Galactose, L-sorbitose, sucrose, maltose, cellobiose, lactose, melibiose, raffinose, melezitose, inulin, soluble starch, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, Methyl-α-D-glucoside, D-glucanate, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and potassium nitrate (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physically, *Phy. aceris* differs from its closely related species *Phy. corallina* in its inability to assimilate glycerol, D-glucanate, DL-lactate and sodium nitrite (Table S1.22).

**Typus:** China, Bomi county, Tibet, obtained from a leaf of *Acer caudatum*, Sep. 2004, F.-Y. Bai (*holotype* CGMCC 2.2662T preserved in a metabolically inactive state, *ex-type* CBS 15773 = XZ17B1).

**Phylozyma jiayinensis** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828814. Fig. 15C.

**Etymology:** the specific epithet jiayinensis refers to the geographic origin of the type strain, Jiayin, Heilongjiang.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical, 1.4–2.0 × 3.2–7.3 μm and single, budding is polar (Fig. 15C), a sediment is present. After 1 mo at 17 °C, a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and somewhat wrinkled and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, sexual structures are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, trehalose, D-mannitol, D-glucitol (delayed), D-glucanate (weak) and DL-lactate (weak) are assimilated as sole carbon sources. Galactose, L-sorbose, sucrose, maltose, cellobiose, lactose, melibiose, raffinose, melezitose, inulin, soluble starch, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, salicin, citrate, succinate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and potassium nitrate (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Phy. jiayinensis* and its closely related species *Phy. dimennae* and *Phy. corallina* are distinguishable from one another by assimilation of sucrose, D-xylene, glycerol, ribitol, D-glucitol, Methyl-α-D-glucoside, DL-lactate, succinate and sodium nitrite (Table S1.22).

**Typus:** China, Qingshan county, Jiayin, Heilongjiang province, obtained from a leaf of an unidentified plant, Aug. 2014, Q.-M. Wang (*holotype* CGMCC 2.5669T preserved in a metabolically inactive state, *ex-type* CBS 13975 = HLJ25.21).

**Meniscomyces** Q.M. Wang & F.Y. Bai *gen. nov.* MycoBank MB828815.

**Etymology:** the genus is named after the lunately shaped vegetative cells.

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Fig. 15. Vegetative cells grown in YM broth for 5 d at 17 °C and ballistoconidia produced on corn meal agar after 7 d at 17 °C. (A, B) *Phy. aceris* CGMCC 2.2662T; (C) *Phy. jiayinensis* CGMCC 2.5669T; (D) *Meniscomyces* CGMCC 2.5816T; (E) *Sa. melibiophila* CBS 5143T; (F) *Mi. ellipsoideus* CGMCC 2.5664T; (G, H) *Mi. rubellus* CGMCC 2.4444T; (I, J) *Mi. pseudomagnisporus* CGMCC 2.4538T; (K, L) *Sy. mothodendri* CGMCC 2.2613T; (M) *Cy. raffinophilum* CGMCC 2.3822T; (N) *Cy. terricola* CGMCC 2.3823T; (O) *Do. ningxiaensis* CGMCC 2.4451T; (P) *Beg. folicola* CGMCC 2.3164T. Bars = 10 μm.
This genus is proposed for the branch represented by strain CGMCC 2.5818T, which formed a separate clade. Member of the Spiculogloeomycetes. The genus is mainly circumscribed by the phylogenetic analysis of the seven genes dataset, in which it occurred as a separate branch within the Spiculogloeomycetes (Fig. 4A).

Sexual reproduction not known. Colonies cream, butyrous. Budding cells present. Cells special, lunate, allantoid and falcate, which differs from the cell morphology of other taxa in Spiculogloeomycetes (Pucciniomycotina). Pseudohyphae and hyphae not produced. Ballistoconidia not formed.

Type species: Meniscomyces layueensis Q.M. Wang, F.Y. Bai & A.H. Li

Meniscomyces layueensis Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828816. Figs 11E and 15D.

Etymology: the specific epithet layueensis refers to the geographic origin of the type strain, Layue county, Tibet.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal or cylindrical, 6.0–7.5 × 9.0–14.5 μm and single, budding is polar (Fig. 15D), a sediment is present. After 1 mo at 17 °C, a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

Physiological and biochemical characteristics: Glucose fermentation is absent. Sucrose, sucrone, maltose, cellobiose (variable), trehalose, melezitose and succinate are assimilated as sole carbon sources. Galactose, L-sorbose, lactose, melibiose, raffinose, inulin, soluble starch, D-xyllose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin and succinate (delayed) are assimilated as sole nitrogen sources. Maximum growth temperature is 35 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Sa. melibiophila differs from its closely related species Sa. lamellibrachiae and Sa. mei in its ability to assimilate cellobiose, melibiose, ribitol, and nitrate (Table S1.23).

Typus: Netherlands, obtained from bronchial secretion, J. Swieringa (holotype CBS 5143T preserved in a metabolically inactive state, ex-type JCM 8162 = CGMCC 2.4235).

Microsporomycetes ellipsoideus Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828818. Fig. 15F.

Etymology: the specific epithet ellipsoideus refers to the ellipsoidal vegetative cells of the type strain.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal or cylindrical, 6.0–7.5 × 9.0–14.5 μm and single, budding is polar (Fig. 15F), a sediment is formed. After 1 mo at 17 °C, a sediment is formed. After 1 mo at 17 °C, the streak culture is orange-red, butyrous, smooth. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

Physiological and biochemical characteristics: Glucose fermentation is absent. Sucrose, galactose, lactose, L-sorbose, cellobiose, trehalose, melibiose (delayed), D-xyllose, L-arabinose, D-arabinose (delayed), D-ribose (delayed), ethanol, glycerol, ribitol, D-mannitol, salicin, D-glucitol, D-glucurate DL-lactate, succinate, citrate, myo-inositol are assimilated as sole carbon sources. Sucrose, maltose, lactose, raffinose, melezitose, inulin, soluble starch, L-rhamnose, D-glucosamine, methanol, erythritol, galactitol and Methyl-α-D-glucoside are not assimilated. Potassium nitrate, sodium nitrite, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 35 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Mi. ellipsoideus differs from its closely related species Mi. rubellus in its inability to assimilate melezitose, ribitol and galactitol and its ability to soluble starch and Methyl-α-D-glucoside (Table S1.24).

Typus: China, Motuo county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CGMCC 2.5818T preserved in a metabolically inactive state, ex-type CBS 15747 = X2100).

New taxa in Cystobasiomycomycetes (Pucciniomycotina)

Sacaguchia melibiophila M. Groenew., Q.M. Wang, & F.Y. Bai sp. nov. MycoBank MB628817. Fig. 15E

Etymology: the specific epithet melibiophila refers to the physiological character of assimilating melibiose.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal, 2.5–4.4 × 3.8–5.6 μm and single, budding is polar (Fig. 15E), a sediment is formed. After 1 mo at 17 °C, a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is orange-red, butyrous, smooth. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

Physiological and biochemical characteristics: Glucose fermentation is absent. Sucrose, galactose, L-sorbose, cellobiose, trehalose, melibiose (delayed), D-xyllose, L-arabinose, D-arabinose (delayed), D-ribose (delayed), ethanol, glycerol, ribitol, D-mannitol, salicin, D-glucitol, D-glucurate DL-lactate, succinate, citrate, myo-inositol are assimilated as sole carbon sources. Sucrose, maltose, lactose, raffinose, melezitose, inulin, soluble starch, L-rhamnose, D-glucosamine, methanol, erythritol, ribitol, galactitol, D-mannitol, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine and ethylamine hydrochloride (weak) are assimilated as sole nitrogen sources. Sodium nitrate and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Typus: China, Layue county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CGMCC 2.5818T preserved in a metabolically inactive state, ex-type CBS 15747 = X2100).
2.5664_T preserved in a metabolically inactive state, ex-type CBS 15620 = XZ137E4).

**Microsporomyces rubellus** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828819. Fig. 15G, H.

**Etymology:** the specific epithet **rubellus** refers to the pale red colony colour of this species.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ovoid and ellipsoidal, 3.8–6.2 × 5.1–8.1 μm and single, budding is polar (Fig. 15G), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale-red, butyrous, smooth and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, streak culture is orange, butyrous, wrinkled and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, trehalose, melibiose, raffinose, melezitose, glycerol (delayed and weak), ribitol, galactitol, D-mannitol (delayed and weak), D-glucitol (weak), salicin (variable) and DL-lactate (variable) are assimilated as sole carbon sources. L-sorbitose, cellobiose, lactose, soluble starch, D-xylose, L-arabinose, D-ribose, L-rhamnose, D-glucosamine, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 19 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Physiologically,** **Mi. pseudomagnisporus** differs from its closely related species **M. magnisporus** in its inability to assimilate maltose, soluble starch, N-Acetyl-D-glucosamine, DL-lactate, citrate and sodium nitrite and its ability to assimilate inulin, ethanol, L-lysine, ethylamine and cadaverine (Table S1.24).

**Symmetrospora rhododendri** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828821. Fig. 15K, L.

**Etymology:** the specific epithet **rhododendri** refers to *Rhododendron*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical and ellipsoidal, 3.4–4.7 × 6.6–9.4 μm and single, budding is polar (Fig. 15K), a sediment is formed. After 1 mo at 17 °C, a part ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pinkish orange, butyrous, slight wrinkled and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.5–3.3 × 5.8–8.3 μm (Fig. 15J).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, L-sorbitose, sucrose, trehalose (weak), melibiose (weak), raffinose (weak), melezitose (weak), inulin (delayed), D-arabinose (weak), ethanol, ribitol (weak), D-mannitol (weak), D-glucitol (weak), Methyl-α-D-glucoside (weak) and succinate (weak) are assimilated as sole carbon sources. Maltose, cellobiose, lactose, soluble starch, D-xylose, L-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, erythritol, galactitol, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 25 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Physiologically,** **Sy. rhododendri** differs from its closely related species **Sy. cypriosmae** and **Sy. oryzicola** in its inability to assimilate L-sorbitose, cellobiose, melezitose, D-arabinose, D-mannitol, D-glucitol and succinate (weak) and succinate (weak) are assimilated as sole carbon sources. Maltose, cellobiose, lactose, soluble starch, D-xylose, L-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, erythritol, galactitol, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 19 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.
ribose, Methyl-α-D-glucoside, salicin and DL-lactate and its ability to assimilate lactose, inulin, nitrate and cadaverine (Table S1.25).

**Typus:** China, Lulang county, Tibet, obtained from a leaf of *Rhododendron sp.*, Sep. 2004, F.-Y. Bai (*holotype* CGMCC 2.2613 \(^1\) preserved in a metabolically inactive state, ex-type CBS 15447 = XZ49DX).

**New combinations for Symmetrospora**

*Symmetrospora oryzicola* (Nakase & M. Suzuki) Q.M. Wang & F.Y. Bai, **com. nov.** MycoBank MB832091.

*Basionym:* Sporobolomyces oryzicola Nakase & M. Suzuki, J. Gen. Appl. Microbiol., 32(2): 152 (1986).

*Symmetrospora raffinolium* Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.** MycoBank MB828822. Fig. 15M.

**Etymology:** the specific epithet *raffinolium* refers to the ability to assimilate raffinose.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal, 3.1–5.0 × 4.5–6.8 μm and single, budding is polar (Fig. 15M), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pink-red, mucoid, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose (variable), L-sorbose (variable), sucrose, cellulose, trehalose, lactose, raffinose (variable), melezitose, D-xylose, L-arabinose, D-arabinose (delayed and weak), D-ribose, ethanol, glycerol, ribitol, D-mannitol, D-glucitol, salicin, DL-lactate (delayed and weak), succinate and citrate (variable) are assimilated as sole carbon sources. Maltose, melibiose, inulin, soluble starch, L-ribose, D-glucosamine, melibiose, erythritol, galactitol, Methyl-α-D-glucoside, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (delayed and weak), sodium nitrite (delayed and weak), L-lysine (delayed and weak), ethylamine hydrochloride (delayed and weak) and cadaverine dihydrochloride (delayed and weak) are assimilated as sole nitrogen sources. Maximum growth temperature is 35 °C. Growth in vitamin-free medium is weak. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Cy.* *terricola* and its three closely related species, *Cy.* *raffinolium*, *Cy.* *minutum* and *Cy.* *fitematum*, are distinguishable by the assimilation of L-sorbose, galactose, lactose, raffinose, melezitose, galactitol, D-glucitol, salicin, DL-lactate and potassium nitrate (Table S1.26). *Cy.* *raffinolium* differs from its closely related species *Cy.* *fitematum* in its inability to assimilate lactose, salicin, DL-lactate and its ability to assimilate galactose, raffinose, melezitose, galactitol and potassium nitrate (Table S1.26).

**Typus:** China, Yecheng county, Xinjiang province, obtained from soil, Jul. 2007, Q.-M. Wang (*holotype* CGMCC 2.3823 \(^1\) preserved in a metabolically inactive state, ex-type CBS 15650 = 140.23).

*Robertozyma* Q.M. Wang & F.Y. Bai **gen. nov.** MycoBank MB828824.

**Etymology:** the genus is named in honour of Dr. V. Robert for his contributions to the yeast taxonomy.

This genus is proposed for the branch represented by strain CGMCC 2.4451 which formed a separate clade. Member of the Cystobasidiales (Cystobasidiomycetes). The genus is mainly circumscribed by the phylogenetic analysis of the seven genes dataset, in which it occurred as a separate branch within the Cystobasidiales (Fig. 4).

Sexual reproduction not known. Colonies orange, butyrous. Budding cells present. Pseudohyphae and hyphae not produced. Ballistoconidia not formed.

**Type species:** *Robertozyma ningxiaensis* Q.M. Wang, F.Y. Bai & A.H. Li.

**Note:** *Robertozyma* and its closely related genera, *Begerowomyces* and *Halobasidium*, have a similar colony morphology, however, they can be distinguished by some physiological characters (Table S1.27). *Robertozyma* does not assimilate sucrose, melezitose, D-xylose and ethanol, whereas species of *Begerowomyces* and *Halobasidium* can use them. *Begerowomyces* species assimilate erythritol and galactitol, whereas species of *Robertozyma* and *Halobasidium* do not assimilate these two carbon resources.
**Robertozyma ningxiaensis** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828826. *Figs. 15O.*

**Etymology:** the specific epithet *ningxiaensis* refers to the geographic origin of the type strain, Ningxia province, China.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are oval and ellipsoidal, 3.2–4.5 × 3.9–6.8 μm and single, budding is polar (*Fig. 15O*), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is orange red, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on com meal agar, pseudozystyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose (delayed and weak), sucrose (delayed), maltose (delayed and weak), cellobiose (delayed and weak), trehalose (delayed and weak), melezitose, inulin (delayed and weak), D-xyllose, L-arabinose (delayed and weak), ethanol, erythritol (delayed), ribitol, galactitol, D-mannitol (delayed), D-glucitol (delayed) and succinate (delayed) are assimilated as sole carbon sources. L-sorbose, lactose, melibiose, raffinose, soluble starch, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, Methyl-α-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (delayed and weak), L-lysine and ethylamine hydrochloride are assimilated as sole nitrogen sources. Sodium nitrite and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Typus: Germany,** obtained from a leaf of an unidentified plant, Sep. 2005 (*holotype* CGMCC 2.3164*³* preserved in a metabolically inactive state, ex-type CBS 15655 = G7.4).

**New taxa in Microbotryomycetes (Pucciniomycotina)**

**Rosettozymales** Q.M. Wang & F.Y. Bai *ord. nov.* MycoBank MB828829.

Member of the *Microbotryomycetes*. The diagnosis of the order *Rosettozymales* is based on the *genus Rosettozyma*. The nomenclature of the order is based on the genus *Rosettozyma*.

**Type family: Rosettozymaceae** Q.M. Wang & F.Y. Bai.

**Rosettozymaceae** Q.M. Wang & F.Y. Bai *fam. nov.* MycoBank MB828830.

Member of the *Rosettozymales* (*Microbotryomycetes*). The diagnosis of the family *Rosettozymaceae* is based on the genus *Rosettozyma*. The nomenclature of the family is based on the genus *Rosettozyma*.

**Type genus: Rosettozyma** Q.M. Wang & F.Y. Bai.

**Genus accepted: Rosettozyma** Q.M. Wang & F.Y. Bai.

**Rosettozyma** Q.M. Wang & F.Y. Bai *gen. nov.* MycoBank MB828831.

**Etymology:** the genus is named based on the morphology of the vegetative cells forming a rosette.

This genus is proposed for the clade represented by CGMCC 2.3446, which formed a separate clade from other orders and taxa in the *Microbotryomycetes*. Member of *Microbotryomycetes*. The genus is mainly circumscribed by the phylogenetic analysis of the seven genes dataset, in which it occurred as a separate clade within the *Microbotryomycetes* (*Fig. 4*).

Sexual reproduction not known. Colonies white, butyrous. Budding cells present and always form rosette-like clusters. Pseudozyphae and hyphae not produced. Ballistoconidia formed.
Type species: Rosettozyma petaloides Q.M. Wang, F.Y. Bai & A.H. Li.

Note: Except the genus Rosettozyma, species in Yamadamycoses and Meredithblackwellia also form rosette-like cell clusters (Golubev & Scorzetli 2010, Toome et al. 2013).

Rosettozyma petaloides Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828832. Figs 11G, H and 16A, B.

Etymology: the specific epithet petaloides refers to the vegetative cells forming a petale morphology of the type strain.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are elongate fusiform, either singly or in rosettes, 2.2–3.2 × 9.8–18.7 μm, budding is polar (Fig. 16A), a sediment is formed. After 1 mo at 17 °C, a pellicle and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is whitish to cream, butyrous, slightly wrinkled and semi-glossy. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or falcate, 1.7–2.8 × 7.7–15.4 μm (Fig. 16D).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, sucrose, maltose, trehalose, melezitose, L-arabinose (variable), D-arabinobiose, ethanol, erythritol (variable), D-mannitrol, D-glucitol, Methyl-α-D-glucoside (variable) and salicin are assimilated as sole carbon sources. Galactose, L-sorbitose, cellobiose, lactose, melibiose, raffinose, inulin, soluble starch, D-xyllose, D-xylose, L-rhamnose, D-glucosamine, methanol, glycerol, ribitol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Ureaase activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Ro. cystopteridis and its two closely related species, Ro. petaloides and Ro. motuoensis, can be distinguished from one another by the assimilation of D-xylose, L-arabinobiose, glucosamine and succinate. Ro. cystopteridis differs from Ro. petaloides in its inability to assimilate D-xylose and glycerol. Ro. cystopteridis differs from Ro. motuoensis in its inability to assimilate succinate and its ability to assimilate D-arabinobiose (Table S1.28).

Typus: China, Bomi county, Tibet, obtained from a leaf of Cystopteris moupinensis, Sep. 2004, F.-Y. Bai (holotype: CGMCC 2.2615T preserved in a metabolically inactive state, ex-type CBS 15448 = XZ16E1).

Rosettozyma motuoensis Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828834. Figs 16E, F and 17C.

Etymology: the specific epithet motuoensis refers to the geographic origin of the type strain, Motuo, Tibet.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoid, either singly or in rosettes, 2.2–2.8 × 11.4–20.3 μm, budding is polar (Fig. 16C), a sediment is formed. After 1 mo at 17 °C, a pellicle and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is whitish to cream, butyrous, slightly wrinkled, semi-glistening. The margin is entire. In Dalmat plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or falcate, 1.7–2.8 × 7.7–15.4 μm (Fig. 16D).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, sucrose, maltose, trehalose, melezitose, L-arabinose (variable), D-arabinobiose, ethanol, erythritol (variable), D-mannitrol, D-glucitol, Methyl-α-D-glucoside (variable) and salicin are assimilated as sole carbon sources. Galactose, L-sorbitose, cellobiose, lactose, melibiose, raffinose, inulin, soluble starch, D-xyllose, D-xylose, L-rhamnose, D-glucosamine, methanol, glycerol, ribitol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Ureaase activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Ro. cystopteridis and its two closely related species, Ro. petaloides and Ro. motuoensis, can be distinguished from one another by the assimilation of D-xylose, L-arabinobiose, glucosamine and succinate. Ro. cystopteridis differs from Ro. petaloides in its inability to assimilate D-xylose and glycerol. Ro. cystopteridis differs from Ro. motuoensis in its inability to assimilate succinate and its ability to assimilate D-arabinobiose (Table S1.28).

Fig. 16. Vegetative cells grown in YM broth for 5 d at 17 °C and ballistoconidia produced on corn meal agar after 7 d at 17 °C. (A, B) Ros. petaloides CGMCC 2.3446T; (C, D) Ros. cystopteridis CGMCC 2.2615T; (E, F) Ros. motuoensis CGMCC 2.5815T; (G, H) Sp. cellobiolyticus CGMCC 2.5675T; (I, J) Sp. reniformis CGMCC 2.5627T; (K, L) Sp. ellipsodeus CGMCC 2.5619T; (M, N) Sp. primognomicus IAM13481T; (O, P) Rh. platycladi CGMCC 2.3118T. Bars = 10 μm.
Fig. 17. SEM image of vegetative cells grown in YM broth for 5 d at 17 °C. (A, B) Ros. cystopteridis CGMCC 2.2615T, A Bars = 10 μm, B Bars = 2 μm; (C) Ros. motuoensis CGMCC 2.5819T, Bars = 10 μm; (D) He. tridentata CGMCC 2.5602T, Bars = 10 μm; (E, F) He. cylindrica CGMCC 2.5650T, E Bars = 20 μm, F Bars = 5 μm; (G) Ya. terricola CGMCC 2.5820T, Bars = 10 μm; (H) Ch. rhododendri CGMCC 2.5921T, Bars = 5 μm.
rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, erythritol, ribitol, galactitol, salicin, D-glucanate, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine and ethylamine hydrochloride are assimilated as sole nitrogen sources. Sodium nitrite and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 22–23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/v) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Ro. motuoensis and their two closely related species, Ro. petaloides and Ro. cystopteridis, can be distinguished from one another by the assimilation of D-xylose, L-arabinose, D-arabinose, glycerol and succinate. Ro. motuoensis differs from Ro. petaloides in its inability to assimilate D-xylene, L-arabinose and glycerol and its ability to assimilate succinate. Ro. motuoensis differs from Ro. cystopteridis in its inability to assimilate D-arabinose and its ability to assimilate succinate (Table S1.28).

Typus: China, Motuo, Tibet, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CBS 13964 = HLJ33B4) preserved in a metabolically inactive state, ex-type CBS 15588 = XZ118E6).

Sporobolomyces reniformis Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828836. Fig. 16I, J.

Etymology: the specific epithet reniformis refers to the reniform ballistoconidia.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal to ovoid, 3.8–5.7 × 5.8–10.7 μm and single, budding is polar (Fig. 16I), a sediment is formed. On YM agar, after 1 mo at 17 °C, the streak culture is orange, butyrous, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal or reniform, 2.8–3.8 × 7.5–10.0 μm (Fig. 16J).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, L-sorbose, sucrose, maltose, trehalose, raffinose, ethanol (delayed and weak) and DL-lactate are assimilated as sole carbon sources. Galactose, cellobiose, lactose, melibiose, melezitose, inulin, soluble starch, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin, D-glucanate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, and cadaverine dihydrochloride (delayed and weak) are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, L-lysine and ethylamine hydrochloride are not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Sp. reniformis differs from its closely related species Sp. ellipsoides in its inability to assimilate melezitose, D-mannitol and D-glucitol (Table S1.29).

Typus: China, Wuyiling natural reserve, Heilongjiang province, obtained from a leaf of an unidentified plant, Sep. 2014, Q.-M. Wang (holotype CGMCC 2.5627T preserved in a metabolically inactive state, ex-type CBS 13964 = HLJ33B4).

Sporobolomyces celllobiolyticus Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828835. Fig. 16G, H.

Etymology: the specific epithet celllobiolyticus refers to the physiological character of assimilating cellobiose.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ovoid, ellipsoidal and cylindrical, 2.6–4.8 × 5.6–12.0 μm and single, budding is polar (Fig. 16G), a sediment is formed. On YM agar, after 1 mo at 17 °C, the streak culture is orange, butyrous, smooth. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoidal or reniform, 1.9–3.2 × 5.1–7.1 μm (Fig. 16H).

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, galactose (variable), L-sorbose (variable), trehalose, raffinose, ethanol (delayed), melibiose, melezitose, inulin, salicin, D-ribose, L-arabinose, D-arabinose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, α-arabinose, glycerol, rhamnose, D-glucosamine, sucrose, maltose, trehalose, raffinose, ethanol (delayed and weak) and DL-lactate are assimilated as sole carbon sources. Galactose, cellobiose, lactose, melibiose, melezitose, inulin, soluble starch, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin, D-glucanate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, and cadaverine dihydrochloride (delayed and weak) are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, L-lysine and ethylamine hydrochloride are not assimilated. Maximum growth temperature is 30 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Sp. celllobiolyticus differs from its closely related species Sp. filinesis in its inability to assimilate soluble starch and D-xylene and its ability to assimilate cellobiose and inulin (Table S1.29).
starch (variable), D-ribose (variable), L-arabinose (variable), D-arabinose (variable), L-rhamnose (variable), D-glucosamine (variable), ethanol (variable), glycerol (variable), ribitol (variable), D-mannitol, D-glucitol, Methyl-α-D-glucoside (variable), DL-lactate (variable), succinate (variable), citrate (variable) and salicin (variable) are assimilated as sole carbon sources. Melibiose, D-xylene, N-Acetyl-D-glucosamine, D-glucurionate, methanol, erythritol, galactitol, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, Sodium nitrite (variable), L-lysine, ethylamine hydrochloride (variable) and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Sp. ellipsoideus differs from its closely related species Sp. reniformis in its ability to assimilate meleziotose, D-mannitol and D-glucitol (Table S1.29).

Typus: China, Milin county, Tibet, obtained from an leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (holotype CGMCC 2.5619T preserved in a metabolically inactive state, ex-type CBS 15590 = GPS21.5C1).

*Sporobolomyces primogenomicus* Q.M. Wang & F.Y. Bai sp. nov. MycoBank MB828838. Fig. 16M, N.

**Etymology:** the specific epithet *primogenomicus* refers to the fact that the type strain was the first sequenced genome in the Pucciniomycotina.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal, 2.0–3.8 × 3.0–5.6 μm and single, budding is polar (Fig. 16M), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale cream, butyrous, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.0–2.7 × 3.3–5.8 μm (Fig. 16N).

**Physiological and biochemical characteristics:** Glucose, galactose, L-sorbose, sucrose, maltose, cellobiose, trehalose, raffinose, meleziotose, D-xylene, L-arabinose, glycerol, ribitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside (weak) and salicin (weak) are assimilated as sole carbon sources. Lactose, maltose, melibiose, inulin, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, erythritol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Potassium nitrate (weak) is assimilated as sole nitrogen sources.

Physiologically, Sp. *primogenomicus* differs from its closely related species *Sp. ruberrimus* in its ability to assimilate L-sorbose, trehalose, meleziotose, D-xylene, L-arabinose, glycerol, ribitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside (weak) and salicin (weak) are assimilated as sole carbon sources. Lactose, maltose, cellobiose, trehalose, raffinose, meleziotose, D-xylene, L-arabinose, glycerol, ribitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside (weak) and salicin (weak) are assimilated as sole carbon sources. Lactose, maltose, melibiose, inulin, L-rhamnose, erythritol, galactitol and myo-inositol are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Ammonium sulfate, potassium nitrate, sodium nitrate (weak), L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride (weak) are assimilated as sole nitrogen sources. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Rh. platycladi* differs from its closely related species *Rh. nylandii* in its inability to assimilate soluble starch, D-arabinose, D-ribose, ethanol and succinate and its ability to assimilate D-xylene, L-arabinose and L-lysine (Table S1.30).

Typus: China, Beijing, obtained from a leaf of *Platyclusus orientalis*, Mar. 2006, S.-A. Wang (holotype CGMCC 2.3118T preserved in a metabolically inactive state, ex-type CBS 15468 = BJ6-3).

*Rhodospiridibolus jianfalingensis* Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828840. Fig. 18A, B.

**Etymology:** the specific epithet *platycladi* refers to *Platyclusus*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and ovoid, 4.0–6.2 × 5.5–9.7 μm and single, budding is polar (Fig. 16O), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale cream, butyrous, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoid or reniform, 3.1–5.0 × 7.0–10.0 μm (Fig. 16P).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, L-sorbose (weak), sucrose, maltose, cellobiose, trehalose, raffinose, meleziotose, D-xylene, L-arabinose, glycerol, ribitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside (weak) and salicin (weak) are assimilated as sole carbon sources. Galactose, lactose, melibiose, inulin, soluble starch, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, erythritol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, sodium nitrate (weak), L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride (weak) are assimilated as sole nitrogen sources. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Rh. platycladi* differs from its closely related species *Rh. nylandii* in its inability to assimilate soluble starch, D-arabinose, D-ribose, ethanol and succinate and its ability to assimilate D-xylene, L-arabinose and L-lysine (Table S1.30).

Typus: China, Beijing, obtained from a leaf of *Platyclusus orientalis*, Mar. 2006, S.-A. Wang (holotype CGMCC 2.3118T preserved in a metabolically inactive state, ex-type CBS 15468 = BJ6-3).

**Rhodospiridibolus jianfalingensis** Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828840. Fig. 18A, B.

**Etymology:** the specific epithet *platycladi* refers to *Platyclusus*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal and ovoid, 4.0–6.2 × 5.5–9.7 μm and single, budding is polar (Fig. 16O), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is pale cream, butyrous, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are ellipsoid or reniform, 3.1–5.0 × 7.0–10.0 μm (Fig. 16P).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, L-sorbose (weak), sucrose, maltose, cellobiose, trehalose, raffinose, meleziotose, D-xylene, L-arabinose, glycerol, ribitol, D-mannitol, D-glucitol, Methyl-α-D-glucoside (weak) and salicin (weak) are assimilated as sole carbon sources. Galactose, lactose, melibiose, inulin, soluble starch, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, erythritol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, sodium nitrate (weak), L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride (weak) are assimilated as sole nitrogen sources. Maximum growth temperature is 32 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Rh. platycladi* differs from its closely related species *Rh. nylandii* in its inability to assimilate soluble starch, D-arabinose, D-ribose, ethanol and succinate and its ability to assimilate D-xylene, L-arabinose and L-lysine (Table S1.30).

Typus: China, Beijing, obtained from a leaf of *Platyclusus orientalis*, Mar. 2006, S.-A. Wang (holotype CGMCC 2.3118T preserved in a metabolically inactive state, ex-type CBS 15468 = BJ6-3).
Etymology: the specific epithet *jianfalingensis* refers to the geographic origin of the type strain, Jianfaling, Hainan.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical, 1.4–2.9 × 4.3–10.0 μm and single, budding is polar (Fig. 18A), a sediment is present. After 1 mo at 17 °C, a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is pale cream, butyrous, smooth and glossy. The margin is entire or eroded. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.1–2.9 × 5.0–7.1 μm (Fig. 18B).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose, sucrose, maltose, cellobiose, trehalose, lactose (weak), melezitose (weak), raffinose, melezitose, soluble starch, D-xylene, L-arabinose, D-arabinose (weak), D-ribose (weak), L-rhamnose, D-glucosamine (weak), Methyl-α-D-glucoside, salicin, succinate (weak) and citrate (weak) are assimilated as sole carbon sources. L-sorbose, inulin, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, D-mannitol, D-glucitol, DL-lactate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, sodium nitrate and L-lysine (delayed and weak) are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Rh. fuzhouensis* differs from its closely related species *Rh. lusitaniae* in its inability to assimilate galactitol, citrate, potassium nitrate and sodium nitrite (Table S1.30).

**Typus:** China, Jinghong, Yunnan province, obtained from a leaf of an unidentified plant, Aug. 2011, Q.-M. Wang (holotype CGMCC 2.4435\textsuperscript{T} preserved in a metabolically inactive state, ex-type CBS 12492 = FJYZ2-6).

**Heitmaniales** Q.M. Wang & F.Y. Bai *ord. nov.* MycoBank MB828842.

Member of the Microbotryomycetes. The diagnosis of the order *Heitmaniales* is based on the the genus *Heitmania*. The nomenclature of the order is based on the genus *Heitmania*. The type family: *Heitmaniaceae* Q.M. Wang & F.Y. Bai.

**Heitmaniaceae** Q.M. Wang & F.Y. Bai *fam. nov.* MycoBank MB828843.

Member of the Microbotryomycetes. The diagnosis of the family *Heitmaniaceae* is based on the the genus *Heitmania*. The nomenclature of the family is based on the genus *Heitmania*. The type genus: *Heitmania* X.Z. Liu, F.Y. Bai, M. Groenew. & Boekhout, Index Fungorum 381: 1 (2018).

**Genus accepted:** *Heitmania* X.Z. Liu, F.Y. Bai, M. Groenew. & Boekhout, Index Fungorum 381: 1 (2018).

**Synonyms:** *Heitmania* X.Z. Liu, F.Y. Bai, M. Groenew. & Boekhout, Int. J. Syst. Evol. Microbiol. 67: 4538 (2017), nom. inval., Art. 40.1 (Shenzhen).

**Heitmania tridentata** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828841. Figs 17D and 18E.

Etymology: the specific epithet *tridentata* refers to the vegetative cell morphology of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical and ellipsoidal, 2.6–3.4 × 5.9–12.0 μm and single, budding is polar, usually tridentate (Fig. 18E), a sediment is formed. After 1 mo at 17 °C, a part ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, maltose, trehalose, ethanol and D-mannitol (weak) are assimilated as sole carbon sources. Galactose, L-sorbose, sucrose, cellobiose, lactose, melezitose, raffinose, melezitose, inulin, soluble starch, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, methanol, glycerol, erythritol, galactitol, Methyl-α-D-glucoside, gluton, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate and L-lysine (delayed and weak) are assimilated as sole nitrogen sources. Potassium nitrate, sodium nitrite, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Rh. fuzhouensis* differs from its closely related species *Rh. lusitaniae* in its inability to assimilate galactitol, citrate, potassium nitrate and sodium nitrite (Table S1.30).
not assimilated. Maximum growth temperature is 22–23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, He. tridentata differs from its closely related species He. cylindrica in its inability to assimilate melezitose, glycerol, D-glucitol, succinate and ethylamine (Table S1.31).

**Type**: China. Milin county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (holotype CGMCC 2.5602 T preserved in a metabolically inactive state, ex-type CBS 15549 = GPS20.16B3).

*Heitmania cylindrica* Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.** MycoBank MB828845. Figs 17E, F and 18F.

**Etymology**: the specific epithet cylindrica refers to the vegetative cell morphology of the type strain.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are elongate cylindrical, 2.5–3.4 × 9.9–16.3 μm and single, budding is polar (Fig. 18F), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, sucrose, maltose, cellobiose, trehalose, lactose, melezitose, D-xylose, D-ribose (delayed and weak), glycerol, ribitol (delayed and weak), D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin and succinate (delayed and weak) are assimilated as sole carbon sources. Galactose, meleitoise, raffinose, inulin, soluble starch, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucomose, methanol, erythritol, ribitol, galactitol, Methyl-α-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate and ethylamine hydrochloride are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Mic. swertiae differs from its closely related species *Mic. collaris* in its inability to assimilate D-gluconate, DL-lactate and sodium nitrite (Table S1.32).

**Type**: China, Chuxiong county, Yunnan province, obtained from a leaf of *Swertia yunnanensis*, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.3833 T preserved in a metabolically inactive state, ex-type CBS 15495 = ZXS7.7).

*Yamadamycyes terricola* Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.** MycoBank MB828847. Figs 17G and 18H.

**Etymology**: the specific epithet terricola refers to the substrate from which the type strain was isolated, soil.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are fusiform, 2.5–3.4 × 6.0–11.8 μm and single, budding is polar (Fig. 18H), a sediment is formed. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, sucrose, maltose, trehalose, melezitose, D-glucosamine (delayed and weak), ethanol, glycerol, D-mannitol, D-glucitol and succinate are assimilated as sole carbon sources. Galactose, L-sorbos, cellobiose, lactose, melibiose, raffinose, inulin, soluble starch, D-xylose, L-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, erythritol, ribitol, galactitol, Methyl-α-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Maximum growth temperature is 22–23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Mic. swertiae* differs from its closely related species *Mic. collaris* in its inability to assimilate D-gluconate, DL-lactate and sodium nitrite. (Table S1.32).

**Type**: China, Milin county, Tibet, obtained from a leaf of *Swertia swertiae*, Jul. 2015, Q.-M. Wang (holotype CGMCC 2.3533 T preserved in a metabolically inactive state, ex-type CBS 15495 = GPS20.2C8).

**Microbotryozyma swertiae** Q.M. Wang, F.Y. Bai & A.H. Li **sp. nov.** MycoBank MB828846. Fig. 18G.

**Etymology**: the specific epithet swertiae refers to *Swertia*, the plant genus from which the type strain was isolated.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are cylindrical and lunate, 1.7–2.5 × 3.9–5.6 μm and single, budding is polar (Fig. 18G), a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, L-sorbos (delayed), sucrose, maltose, cellobiose, trehalose, lactose, melezitose, D-xylose, D-ribose (delayed and weak), glycerol, ribitol (delayed and weak), D-mannitol, D-glucitol, Methyl-α-D-glucoside, salicin and succinate (delayed and weak) are assimilated as sole carbon sources. Galactose, melibiose, raffinose, inulin, soluble starch, L-arabinose, D-arabinose, D-ribose, L-rhamnose, N-Acetyl-D-glucosamine, methanol, erythritol, galactitol, Methyl-α-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate and ethylamine hydrochloride are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.
Physiologically, *Ya. terricola* differs from its closely related species *Ya. rosulatus* in its inability to assimilate cellobiose, L-rhamnose, N-Acetyl-D-glucosamine, salicin, D-gluconate, DL-lactate, citrate, myo-inositol, potassium nitrate and sodium nitrite and its ability to grow in vitamin-free medium (Table S1.32).

**Typus:** China, Daxinganling, obtained from soil, Aug, 2015. Q.-M. Wang (*holotype* CGMCC 2.5820T preserved in a metabolically inactive state, ex-type CBS 15572 = 03-1).

**Note:** The genus *Yamadamyces* was invalidly published because its type species was based on an invalid name (Art. 40.1, I.C.N. Shenzhen Code), thus it was validated in the Validated Taxa section.

**Oberwinklerozyma nepetae** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828849. *Fig. 18I.*

**Etymology:** the specific epithet *nepetae* refers to *Nepeta*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical, ellipsoidal and ovoid, 2.7–3.2 × 6.4–8.9 μm and single, budding is polar (*Fig. 18I*), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is white cream, butyrous, smooth and glistening. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, L-sorbose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, D-mannitol, D-glucitol, Methyl-α-D-glucoside and salicin are assimilated as sole carbon sources. Galactose, lactose, inulin, soluble starch, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, ethanol, glycerol, erthritol, ribitol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, sodium nitrite, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *O. dicranopteridis* differs from its closely related species *O. straminea* in its ability to assimilate cellobiose, lactose, D-arabinose, galactitol, Methyl-α-D-glucoside and salicin (Table S1.33).

**Typus:** China, Simao county, Yunnan province, obtained from a leaf of *Dicranopteris dichotoma* (holotype CGMCC 2.3441T preserved in a metabolically inactive state, ex-type CBS 15476 = SM10.2).

**Chrysozyma pseudogriseoofflava** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828850. *Fig. 18K, L.*

**Etymology:** the specific epithet pseudogriseoofflava refers to the similar colony morphology to that of *Chrysozyma griseoflava*.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical, ellipsoidal to fusiform, 3.3–2.3 × 7.7–3.7 μm and single, budding is polar (*Fig. 18K*), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-cream, butyrous, smooth, dult and partly wrinkled. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or cylindrical, 2.3–3.1 × 4.6–7.7 μm (*Fig. 18L*).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, cellobiose, trehalose, melibiose, raffinose, melezitose, ethanol, glycerol, erthritol, ribitol, galactitol, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, sodium nitrite, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 22–23 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.
Physiologically, *Ch. pseudogriseoflava* differs from its closely related species *Ch. griseoflava* in its inability to assimilate galactose, soluble starch, D-xylose, D-arabinose, glycerol, ribitol, D-glucitol, salicin and citrate and its ability to assimilate raffinose, DL-lactate and L-lysine (Table S1.34).

**Typos: China.** Milin county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (*holotype* CGMCC 2.5629) preserved in a metabolically inactive state, ex-type CBS 15564 = GPS21.6B3.

**Chrysozyma sambuci** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828851. Fig. 18M, N.

**Etymology:** the specific epithet *sambuci* refers to Sambucus, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are long ellipsoidal and cylindrical, 2.4–4.0 × 7.2–13.5 μm and single, budding is polar (Fig. 18M), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 2.2–2.9 × 5.9–8.8 μm (Fig. 18N).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, cellobiose, trehalose, melezitose, ethanol (weak), D-glucitol (delayed and weak), D-mannitol and salicin (delayed) are assimilated as sole carbon sources. L-sorbic acid, lactose, melezitose, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate and ethylamine hydrochloride are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ch. forrestii* differs from its closely related species *Ch. rhododendri* in its inability to assimilate raffinose, D-xylose, L-arabinose, ethanol and Methyl-α-D-glucoside (Table S1.34).

**Typos: China.** Bomi county, Tibet, obtained from a leaf of *Iris forrestii*, Sep. 2004, F.-Y. Bai (*holotype* CGMCC 2.2769) preserved in a metabolically inactive state, ex-type CBS 15461 = XZ2B3.

**Chrysozyma rhododendri** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828853. Figs 17H and 18P.

**Etymology:** the specific epithet *rhododendri* refers to *Rhododendron*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical to long ellipsoidal, 1.9–3.7 × 7.5–12.5 μm and single, budding is polar (Fig. 18P), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, mucoid, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose (weak), sucrose, maltose, cellobiose, trehalose, melezitose, inulin (weak), D-glucitol (delayed and weak), D-mannitol and salicin (delayed) are assimilated as sole carbon sources. L-sorbic acid, lactose, melezitose, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate and ethylamine hydrochloride are assimilated as sole nitrogen sources. Sodium nitrite, L-lysine and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 28 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.
Physiologically, *Ch. rhododendri* differs from its closely related species *Ch. iridis* in its ability to assimilate raffinose, D-xylose, L-arabinose, ethanol and Methyl-α-D-glucoside (Table S1.34).

**Typus:** *China*, Tibet, obtained from a leaf of *Rhododendron* sp., Sep. 2014, Q.-M. Wang (holotype CGMCC 2.25821\(^1\) preserved in a metabolically inactive state, ex-type CBS 15583 = XZ160D3).

*Chrysosyza fusiformis* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828854. Fig. 19A, B.

**Etymology:** the specific epithet *fusiformis* refers to the fusiform vegetative cells of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are ellipsoidal to fusiform, 3.0–4.6 × 4.7–8.2 μm and single, budding is polar (Fig. 19A), a sediment is present. After 1 mo at 17 °C, a ring and sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and dull surface. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or falcate, 2.1–2.9 × 6.4–7.9 μm (Fig. 19D).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, trehalose, melezitose, inulin (delayed and weak), D-mannitol and D-glucitol are assimilated as sole carbon sources. Galactose, L-sorbose, cellobiose, lactose, melibiose, raffinose, soluble starch, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, methanol, ethanol, glycerol, erythritol, ribitol, galactitol, Methyl-α-D-glucoside, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak) and sodium nitrite are assimilated as sole nitrogen sources. L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is variable. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Ch. sorbariae* differs well from other *Chrysosyza* species in its assimilation of carbon and nitrogen sources (Table S1.34).

**Typus:** *China*, Bomi county, Tibet, obtained from a leaf of *Sorbaria arboricola*, Sep. 2004, F.-Y. Bai (holotype CGMCC 2.2768\(^2\) preserved in a metabolically inactive state, ex-type CBS 15460 = XZ9D1).

*Chrysosyza cylindrica* Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov.* MycoBank MB828856. Fig. 19E, F.

**Etymology:** the specific epithet *cylindrica* refers to the cylindrical vegetative cells of the type strain.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical, 2.2–3.2 × 3.9–10.0 μm and single, budding is polar (Fig. 19E), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish-cream, butyrous, smooth and semi-glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid or reniform, 1.5–2.5 × 3.8–6.3 μm (Fig. 19F).

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, galactose (delay and weak), sucrose, trehalose (delay), melezitose, D-mannitol and D-glucitol are assimilated as sole carbon sources. L-sorbose, maltose, cellobiose, lactose, melibiose, raffinose, inulin, soluble starch, D-xylose, L-arabinose, D-arabinose, D-ribose, L-rhamnose, D-glucosamine, methanol, glycerol, erythritol, ribitol, galactitol, D-glucitol, Methyl-α-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak) and sodium nitrite are assimilated as sole nitrogen sources. L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is variable. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Vegetative cells grown in YM broth for 5 d at 17 °C and ballistoconidia produced on corn meal agar after 7 d at 17 °C. (A, B) *Ch. fusiformis* CGMCC 2.2765\(^3\); (C, D) *Ch. sorbariae* CGMCC 2.2768\(^4\); (E, F) *Ch. cylindrica* CGMCC 2.3455\(^5\); (G) *Ch. flavia* CGMCC 2.5611\(^6\); (H) *Pseu. hydrangeae* CGMCC 2.2796\(^7\); (I, J) *Pseu. lulangensis* CGMCC 2.2612\(^8\); (K, L) *Yu. longicylindrica* CGMCC 2.5603\(^9\); (M) *St. globosa* CGMCC 2.5822\(^10\); (n) *Co. aletridis* CGMCC 2.2768\(^11\); (O) *Co. hydrangeae* CGMCC 2.2768\(^11\); (P) *Co. rhododendri* CGMCC 2.2770\(^12\). Bars = 10 μm.
22–23 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Ch. cylindrica differs well from other Chrysozyma species in its assimilation of carbon and nitrogen sources (Table S1.34).

Typus: China, Wuzhishan mountain, Hainan province, obtained from a leaf of an unidentified plant, Nov. 2006, Q.-M. Wang (holotype CGMCC 2.34551 preserved in a metabolically inactive state, ex-type CBS 15482 = WZS29.2).

Chrysozyma flav a Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828857. Fig. 19G.

Etymology: the specific epithet flav a refers to the yellow colony colour of the type strain.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are ellipsoidal or to cylindrical, 2.1–3.1 × 4.0–10.8 μm and single, budding is polar (Fig. 19G), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is yellow, butyrous, smooth and glossy.

The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, maltose, cellobiose, trehalose, melezitose, inulin (variable), soluble starch (variable), D-xyllose (variable), L-arabinose (variable), D-arabinose (variable), ethanol, ribitol, D-mannitol, D-glucitol and succinate (variable) are assimilated as sole carbon sources. Galactose, L-sorbose, sucrose, lactose, melibiose, raffinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, mannitol, glycerol, erythritol, galactitol, Methyl-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 29 °C. Growth in vitamin-free medium is variable. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, Ps. hy drangeae and its four closely related species, Ps. l u langensis, Ps. bogoriensis, Ps. pustula and Ps. buffoni, can be distinguished from one another by the assimilation of galactose, L-sorbose, melezitose, glycerol, salicin, citrate, potassium nitrate and sodium nitrite (Table S1.35).

Typus: China, Lulang county, Tibet, obtained from a leaf of Hydrangea heteromorpha, Sep. 2004, F.-Y. Bai (holotype CGMCC 2.279617 preserved in a metabolically inactive state, ex-type CBS 15462 = XZ46A1).

Pseudohyphozyma l u langensis Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828859. Fig. 19I, J.

Etymology: the specific epithet l u langensis refers to the geographic origin of the type strain, Lulang county, Tibet.

Culture characteristics: In YM broth, after 7 d at 17 °C, cells are cylindrical, 3.0–4.0 × 8.4–11.1 μm and single, budding is polar (Fig. 19I), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is white cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced. Ammonium sulfate is assimilated as sole nitrogen sources. Growth in vitamin-free medium is variable. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiological and biochemical characteristics: Glucose fermentation is absent. Glucose, maltose, cellobiose, trehalose, melezitose, inulin (variable), soluble starch (variable), D-xyllose (variable), L-arabinose (variable), D-arabinose (variable), ethanol, ribitol, D-mannitol, D-glucitol and succinate (variable) are assimilated as sole carbon sources. Galactose, L-sorbose, sucrose, lactose, melibiose, raffinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, mannitol, glycerol, erythritol, galactitol, Methyl-D-glucoside, salicin, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.
Physically, *Ps. lulangensis* differs from its closely related species *Ps. bogoriensis* in its inability to assimilate galactose, L-sorbose, soluble starch, glycerol and succinate and its ability to grow in vitamin-free medium (Table S1.35).

**Typus: China**, Lulang county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2004, F.-Y. Bai (*holotype* CGMCC 2.2612) preserved in a metabolically inactive state, ex-type CBS 15448 = X250B2.

**Yurkovia longicylindrica** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov*. MycoBank MB828860. Fig. 19K, L.

**Etymology**: the specific epithet *longicylindrica* refers to the elongate cylindrical cells of the type strain.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are elongate cylindrical, 2.5–4.5 × 7.5–15.9 μm and single, budding is polar (Fig. 19K), a sediment is present. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, wrinkled and dull. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are allantoid, falcate or cylindrical, 1.4–2.5 × 7.1–12.9 μm (Fig. 19L).

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, galactose, sucrose, trehalose, melibiose, melezitose, inulin, soluble starch (delayed and weak), D-arabinobiose, ethanol, ribitol, D-mannitol and D-glucitol are assimilated as sole carbon sources. L-sorbose, maltose, cellobiose, lactose, raffinose, D-xyllose, L-arabinose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, erythritol, ribitol, galactitol, D-glucitol, salicin, succinate, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine (weak), ethylamine hydrochloride and cadaverine dihydrochloride are (delayed and weak) are assimilated. Sodium nitrite is not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physically, *Sl. globosa* differs from its closely related species *Sl. tsugae* in its inability to assimilate L-sorbose, D-xyllose, D-glucitol, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak), sodium nitrite, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

**Physiologically**, *Yu. longicylindrica* differs from its closely related species *Yu. mendeliana* and *Yu. nerthusi* in its inability to assimilate L-sorbose, maltose, L-arabinobiose, glycerol and succinate and its ability to assimilate melibiose (Table S1.36).

**Typus: China**, Milin county, Tibet, obtained from a leaf of an unidentified plant, Sep. 2015, Q.-M. Wang (*holotype* CGMCC 2.5822) preserved in a metabolically inactive state, ex-type CBS 15573 = 4–6.

**Colacogloea aletridis** Q.M. Wang, F.Y. Bai & A.H. Li *sp. nov*. MycoBank MB828862. Fig. 19N.

**Etymology**: the specific epithet *aletridis* refers to *Aletris*, the plant genus from which the type strain was isolated.

**Culture characteristics**: In YM broth, after 7 d at 17 °C, cells are ellipsoidal and ovoid, 2.0–3.8 × 3.0–7.6 μm and single, budding is polar (Fig. 19N), a sediment is formed. After 1 mo at 17 °C, a ring and a sediment are present. On YM agar, after 1 mo at 17 °C, the streak culture is cream, butyrous, smooth and glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics**: Glucose fermentation is absent. Glucose, sucrose, maltose, trehalose, lactose (weak), melezitose (delayed and weak), ethanol, glycerol, D-mannitol, Methyl-α-D-glucoside (delayed and weak) and D-glucurate (weak) are assimilated as sole carbon sources. Galactose, L-sorbose, melibiose, raffinose, inulin, soluble starch, D-xyllose, L-arabinose, D-arabinobiose, D-ribose, L-rhamnose, D-glucosamine, N-Acetyl-D-glucosamine, methanol, erythritol, ribitol, galactitol, D-glucitol, salicin, succinate, DL-lactate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine (weak), ethylamine hydrochloride and cadaverine dihydrochloride are (delayed and weak) are assimilated as sole nitrogen sources. Sodium nitrite is not assimilated. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Yu. longicylindrica* differs from its closely related species *Yu. mendeliana* and *Yu. nerthusi* in its inability to assimilate L-sorbose, D-xyllose, D-glucitol, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Yu. longicylindrica* differs from its closely related species *Yu. mendeliana* and *Yu. nerthusi* in its inability to assimilate L-sorbose, D-xyllose, D-glucitol, salicin, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate, L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride are assimilated as sole nitrogen sources. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is negative. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.
Physiologically, *Co. aletridis* differ well from other *Colacogloea* species in its assimilation of carbon and nitrogen sources (Table S1.38).

**Typus:** China, Bomi county, Tibet, obtained from a leaf of *Aletris pauciflora*, Sep. 2004, F.-Y. Bai (holotype CGMCC 2.2776<sup>T</sup> preserved in a metabolically inactive state, ex-type CBS 15459 = XZ31A1).

*Colacogloea hydrangeae* Q.M. Wang, F.Y. Bai & A.H. Li sp. nov. MycoBank MB828863. Fig. 19O.

**Etymology:** the specific epithet *hydrangeae* refers to *Hydrangea*, the plant genus from which the type strain was isolated.

**Culture characteristics:** In YM broth, after 7 d at 17 °C, cells are cylindrical and ellipsoidal, 2.7–4.1 × 5.7–10.9 μm and single, budding is polar (Fig. 19O), a sediment is present. On YM agar, after 1 mo at 17 °C, the streak culture is yellowish cream, butyrous, smooth with partly wrinkled, glossy. The margin is entire. In Dalmau plate culture on corn meal agar, pseudohyphae are not formed. Sexual structures are not observed on YM, PDA, V8 and CM agar. Ballistoconidia are not produced.

**Physiological and biochemical characteristics:** Glucose fermentation is absent. Glucose, sucrose, maltose, trehalose, melezitose (delayed), D-glucosamine, ethanol, ribitol (delayed), D-mannitol, D-glucitol and salicin are assimilated as sole carbon sources. Galactose, L-sorbose, cellobiose, lactose, raffinose, melibiose, inulin, soluble starch, D-xylene, L-arabinose, D-arabinose, D-ribose, L-rhamnose, mannitol, glycerol, erythritol, galactitol, Methyl-α-D-glucoside, DL-lactate, succinate, citrate, myo-inositol and hexadecane are not assimilated. Ammonium sulfate, potassium nitrate (weak), sodium nitrite (variable), sodium nitrate (variable), L-lysine, ethylamine hydrochloride and cadaverine dihydrochloride (variable) are assimilated as sole nitrogen sources. Maximum growth temperature is 26–27 °C. Growth in vitamin-free medium is positive. Starch-like substances are not produced. Growth on 50 % (w/w) glucose-yeast extract agar is negative. Urease activity is positive. Diazonium Blue B reaction is positive.

Physiologically, *Co. hydrangeae* differs from its closely related species *Co. rhododendri* in its inability to assimilate salicin and its ability to assimilate glycerol (Table S1.38).

**Typus:** China, Bomi county, Tibet, obtained from a leaf of *Rhododendron lulangense*, Sep. 2004, F.-Y. Bai (holotype CGMCC 2.2770<sup>T</sup> preserved in a metabolically inactive state, ex-type CBS 15652 = X210F1).

**New combination for *Colacogloea Colacogloea subericola* (Bellocq, Villa-Carv., Álv.-Rodríg. & Coque) Q.M. Wang & F.Y. Bai com. nov. MycoBank MB832093.**

**Basionym:** *Rhodotorula subericola* Bellocq, Villa-Carv., Álv.-Rodríg. & Coque, Int. J. Syst. Evol. Microbiol. 57(7): 1670 (2007).

**Validated Taxa**

Usually the type culture of a new yeast species should be conserved in two or more collections when it was described. Thus, two or more collection numbers of type culture were always listed for new species by many yeast taxonomists but often without explicitly indicating the holotype, which, however, resulted in numerous invalidly described species according the Art. 40.7 of the Shenzhen Code (Turland et al. 2018) during the last ten years. In order to avoid this embarrassing situation, 70 invalidly described taxa were validated here.

**Apiotrichum xypolipini** S.O. Suh, C.F. Lee, Gujriar & J.J. Zhou ex Kachakhin, Yuriyev & Boekhout, sp. nov. MycoBank MB831708. For description see Int. J. Syst. Evol. Microbiol. 61(10): 2540 (2011).

**Holotype:** CBS 11841 (preserved in a metabolically inactive state).

**Synonyms:** *Trichosporon xypolipini* S.O. Suh, C.F. Lee, Gujriar & J.J. Zhou, Int. J. Syst. Evol. Microbiol. 61(10): 2540 (2011), nom. inval., Art. 40.7 (Shenzhen).

= *Apiotrichum xypolipini* S.O. Suh, C.F. Lee, Gujriar & J.J. Zhou ex Kachakhin, Yuriyev & Boekhout, Stud. Mycol. 81: 142 (2015), nom. inval., Art. 40.7 (Shenzhen).

**Bannozyma arctica** Vishniac & M. Takash. ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831713. For description see Int. J. Syst. Evol. Microbiol. 60(5): 1217 (2010).

**Holotype:** CBS 9278 (preserved in a metabolically inactive state).

**Synonyms:** *Rhodotorula arctica* Vishniac & M. Takash., Int. J. Syst. Evol. Microbiol. 60(5): 1217 (2010), nom. inval., Art. 40.7 (Shenzhen).

= *Bannozyma arctica* Vishniac & M. Takash. ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 183 (2015), nom. inval., Art. 40.7 (Shenzhen).
**Bullerbasidium panici** Fungsin, M. Takash. & Nakase ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, **sp. nov.** MycoBank MB831675.
For description see Microbiol. Culture Coll. 19(1): 27 (2003).
Holotype: JCM 11819 (preserved in a metabolically inactive state).

Synonyms: *Bullera panici* Fungsin et al., Microbiol. Culture Coll. 19(1): 27 (2003), nom. inval., Art. 40.7 (Shenzhen).
- *Bullerbasidium panici* Fungsin, M. Takash. & Nakase ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 123 (2015), nom. inval., Art. 40.7 (Shenzhen).

**Bullerbasidium siamense** Fungsin, M. Takash. & Nakase ex Q.M. Wang, F.Y. Bai, Boekhout & Nakase, **sp. nov.** MycoBank MB831676.
For description see Microbiol. Culture Coll. 19(1): 29 (2003).
Holotype: JCM 11820 (preserved in a metabolically inactive state).

Synonyms: *Bullera siamensis* Fungsin et al., Microbiol. Culture Coll. 19(1): 29 (2003), nom. inval., Art. 40.6 (Shenzhen).
- *Bullerbasidium siamense* Fungsin, M. Takash. & Nakase ex Q.M. Wang, F.Y. Bai, Boekhout & Nakase, Int. J. Syst. Evol. Microbiol. 61: 214 (2011), nom. inval., Art. 40.6 (Shenzhen).

**Carcinomyces arundinariae** Fungsin, M. Takash. & Nakase ex Yurkov, **sp. nov.** MycoBank MB831698.
For description see Microbiol. Culture Coll. 18(2): 86 (2002).
Holotype: JCM 11818 (preserved in a metabolically inactive state).

Synonyms: *Bullera arundinariae* Fungsin, M. Takash. & Nakase, in Fungsin et al., Microbiol. Culture Coll. 18(2): 86 (2002), nom. inval., Art. 40.6 (Shenzhen).
- *Carcinomyces arundinariae* Fungsin, M. Takash. & Nakase ex Yurkov, Stud. Mycol. 81: 133 (2015), nom. inval., Art. 40.6 (Shenzhen).

**Cystobasidium alpinum** Turchetti, Selbmann, Onofri & Buzzini, **sp. nov.** MycoBank MB831749.
For description see Life 8 (2, no 9): 10 (2018).
Holotype: CBS 14809 (preserved in a metabolically inactive state).

Synonyms: *Cystobasidium alpinum* Turchetti, Selbmann, Onofri & Buzzini, Life 8 (2, no 9): 10 (2018), nom. inval., Art. 40.7 (Shenzhen).

**Cystobasidium portillonense** (Laich, Vaca & R. Chávez) Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, **comb. nov.** MycoBank MB831741.
Basionym: *Rhodotorula portillionensis* Laich, Vaca & R. Chávez, Index Fungorum 361: 1 (2018).
Synonyms: *Rhodotorula portillionensis* Laich, Vaca & R. Chávez, Int. J. Syst. Evol. Microbiol. 63(10): 3889 (2013), nom. inval., Art. 40.7 (Shenzhen).
- *Cystobasidium portillionense* Laich, Vaca & R. Chávez ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 173 (2015), nom. inval., Art. 40.7 (Shenzhen).

**Dexyomyces cylindricus** F.Y. Bai, Q.M. Wang & M. Takash. ex F.Y. Bai & Q.M. Wang, **sp. nov.** MycoBank MB831863.
For description see Int. J. Syst. Evol. Microbiol. 54(5): 1879 (2004).
Holotype: CGMCC AS 2.2308 (preserved in a metabolically inactive state).

**Dexyomyces hubeiensis** F.Y. Bai, Q.M. Wang & M. Takash. ex F.Y. Bai & Q.M. Wang, **sp. nov.** MycoBank MB831864.
For description see Int. J. Syst. Evol. Microbiol. 54(5): 1880 (2004).
Holotype: CGMCC AS 2.2466 (preserved in a metabolically inactive state).

Synonyms: *Bullera hubeiensis* F.Y. Bai, Q.M. Wang & M. Takash., Int. J. Syst. Evol. Microbiol. 54(5): 1880 (2004), nom. inval., Art. 40.7 (Shenzhen).

**Dexyomyces nakasei** F.Y. Bai, Q.M. Wang & M. Takash. ex F.Y. Bai & Q.M. Wang, **sp. nov.** MycoBank MB831865.
For description see Int. J. Syst. Evol. Microbiol. 54(5): 1880 (2004).
Holotype: CGMCC AS 2.2435 (preserved in a metabolically inactive state).

Synonyms: *Bullera nakasei* F.Y. Bai, Q.M. Wang & M. Takash., Int. J. Syst. Evol. Microbiol. 54(5): 1880 (2004), nom. inval., Art. 40.7 (Shenzhen).

**Dioszegia zsoltii** F.Y. Bai, M. Takash. & Nakase, **sp. nov.** MycoBank MB831866.
For description see J. Gen. Appl. Microbiol., 48(1): 21 (2002).
Holotype: CGMCC AS 2.2089 (preserved in a metabolically inactive state).

Synonyms: *Dioszegia zsoltii* F.Y. Bai, M. Takash. & Nakase, J. Gen. Appl. Microbiol., 48(1): 21 (2002), nom. inval., Art. 40.7 (Shenzhen).
- *Dioszegia yunnanensis* F.Y. Bai, M. Takash. & Nakase, J. Gen. Appl. Microbiol., 48(1): 22 (2002), nom. inval., Art. 40.7 (Shenzhen).

**Genolevuria bromeliarum** Landell & P. Valente ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, **sp. nov.** MycoBank MB831695.
For description see Int. J. Syst. Evol. Microbiol. 59(4): 911 (2009).
Holotype: CBS 10424 (preserved in a metabolically inactive state).

Synonyms: *Cryptococcus bromeliarum* Landell & P. Valente, Int. J. Syst. Evol. Microbiol. 59(4): 911 (2009), nom. inval., Art. 40.7 (Shenzhen).

**Glaciozyma** Turchetti, Connell, Thomas-Hall & Boekhout, **gen. nov.** MycoBank MB831869.
For description see Extremophiles 15 (5): 579 (2011).
Type species: *Glaciozyma antarctica* (Fell, Statzell, I.L. Hunter & Phaff) M. Groenew. & Q.M. Wang.
Synonyms: *Glaciozyma Turchetti, Connell, Thomas-Hall & Boekhout, Extremophiles 15 (5): 579 (2011), nom. inval., Art. 40.1, see Arts 6.3, 12.1 (Melbourne).
**Glaciozyma antarctica** (Fell, Statzell, I.L. Hunter & Phaff) M. Groenew. & Q.M. Wang, *comb. nov*. MycoBank MB831870. Basionym: *Leucosporidium antarcticum* Fell, Statzell, I.L. Hunter & Phaff, Antonie van Leeuwenhoek 35 (4): 447 (1970). Synonym: *Glaciozyma antarctica* (Fell, Statzell, I.L. Hunter & Phaff) Turchetti, Connell, Thomas-Hall & Boekhout, Extremophiles 15 (5): 579 (2011), nom. inval., Art. 41.5, see Note 1 (Shenzhen).

**Glaciozyma martini** Turchetti, Connell, Thomas-Hall & Boekhout, *sp. nov*. MycoBank MB831872. For description see Extremophiles 15 (5): 579 (2011). Holotype: CBS 10620 (preserved in a metabolically inactive state).

**Glaciozyma watsonii** Turchetti, Connell, Thomas-Hall & Boekhout, *sp. nov*. MycoBank MB831873. For description see Extremophiles 15 (5): 582 (2011). Holotype: CBS 10986 (preserved in a metabolically inactive state).

**Kockovaella mexicana** Lopandić, O. Molnár & Prillinger ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, *sp. nov*. MycoBank MB831697. For description see Microbiol. Res. 160(1): 8 (2005). Holotype: CBS 8279 (preserved in a metabolically inactive state).

**Kondoa thailandica** Fungsin, Hamam. & Nakase ex Q.M. Wang, M. Groenew., F.Y. Bai & Boekhout, *sp. nov*. MycoBank MB831742. For description see Int. J. Syst. Evol. Microbiol. 51(3): 1210 (2001). Holotype: JCM 10651 (preserved in a metabolically inactive state).

**Kwoniella shandongensis** R. Chen, Yuan M. Jiang & S.C. Wei ex M. Groenew. & Q.M. Wang, *sp. nov*. MycoBank MB828750. For description see Int. J. Syst. Evol. Microbiol. 62: 2775 (2012). Holotype: CGMCC 2.04458 (preserved in a metabolically inactive state).

**Kwoniella shandongensis** Chen et al., Int. J. Syst. Evol. Microbiol. 62: 2775 (2012), nom. inval., Art. 40.7 (Shenzhen).

**Leucosporidium creatinivorum** (Golubev) M. Groenew. & Q.M. Wang, *comb. nov*. MycoBank MB831751. Basionym: *Rhodotorula creatinivora* Golubev, Mikol. Fitopatol. 32(3): 8 (1998), as ‘creatinivora’.

**Leucosporidium fragarium** (J.A. Barnett & Buhagiar) M. Groenew. & Q.M. Wang, *comb. nov*. MycoBank MB831752. Basionym: *Torulopsis fragaria* J.A. Barnett & Buhagiar, J. Gen. Microbiol. 67(2): 237 (1971).

**Leucosporidium intermedium** (Nakase & M. Suzuki) M. Groenew. & Q.M. Wang, *comb. nov*. MycoBank MB831754. Basionym: *Bullera intermedia* Nakase & M. Suzuki, J. Gen. Appl. Microbiol. 32(2): 150 (1986).

**Leucosporidium muscorum** (Di Menna) M. Groenew. & Q.M. Wang, *comb. nov*. MycoBank MB831755. Basionym: *Candida muscorum* Di Menna, J. Gen. Microbiol. 18: 269 (1958).

**Naganishia onofrii** Turchetti, Selbmann & Zucconi ex Yurkov, *sp. nov*. MycoBank MB831673. For description see Extremophiles 19: 157 (2015). Holotype: CBS 13732 (preserved in a metabolically inactive state).

**Naganishia onofrii** Turchetti, Selbmann & Zucconi ex Yurkov, *sp. nov*. MycoBank MB831674. For description see Extremophiles 19: 157 (2015). Holotype: CBS 13732 (preserved in a metabolically inactive state).

**Naganishia onofrii** Turchetti, Selbmann & Zucconi ex Yurkov, *sp. nov*. MycoBank MB831675. For description see Extremophiles 19: 157 (2015). Holotype: CBS 13732 (preserved in a metabolically inactive state).

**Naganishia onofrii** Turchetti, Selbmann & Zucconi ex Yurkov, *sp. nov*. MycoBank MB831676. For description see Extremophiles 19: 157 (2015). Holotype: CBS 13732 (preserved in a metabolically inactive state).

**Naganishia onofrii** Turchetti, Selbmann & Zucconi ex Yurkov, *sp. nov*. MycoBank MB831677. For description see Extremophiles 19: 157 (2015). Holotype: CBS 13732 (preserved in a metabolically inactive state).
= Naganishia vaughanmartiniae Turchetti, Blanchette & Arenz. ex Yurkov, Stud. Mycol. 81: 119 (2015), nom. inval., Art. 40.7 (Shenzhen).

*Nieziomyza* Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, gen. nov. MycoBank MB831677. For description see Stud. Mycol. 81: 123 (2015).

Type species: *Nieziomyza melastomatis* Nakase, Tsuzuki, F.L. Lee & M. Takash. ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 123 (2015), nom. inval., Art. 40.1 (Shenzhen).

**Nieziomyza melastomatis** Nakase, Tsuzuki, F.L. Lee & M. Takash. ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831678. For description see Syst. Appl. Microbiol. 27(5): 562 (2004).

Holotype: JCM 12154 (preserved in a metabolically inactive state).

Synonyms: *Bullera* forma *Nakase et al., Syst. Appl. Microbiol. 27(5): 560 (2004), nom. inval., Art. 40.6 (Shenzhen).

*Nieziomyza formosana* Nakase, Tsuzuki, F.L. Lee & M. Takash. ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831679. For description see Syst. Appl. Microbiol. 27(5): 560 (2004).

Holotype: JCM 12153 (preserved in a metabolically inactive state).

Synonyms: *Bullera* forma *Nakase et al., Syst. Appl. Microbiol. 27(5): 560 (2004), as ‘melastomae’, nom. inval., Art. 40.6 (Shenzhen).

*Oberwinkleromyza silvestris* Golubev & Scorzetti ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831743. For description see Int. J. Syst. Evol. Microbiol. 60(10): 2504 (2010).

Holotype: CBS 11420 (preserved in a metabolically inactive state).

Synonyms: *Rhodotorula silvestris* Golubev & Scorzetti, Int. J. Syst. Evol. Microbiol. 60(10): 2504 (2010), nom. inval., Art. 40.7 (Shenzhen).

*Oberwinkleromyza straminea* Golubev & Scorzetti ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831744. For description see Int. J. Syst. Evol. Microbiol. 60(10): 2505 (2010).

Holotype: CBS 10976 (preserved in a metabolically inactive state).

Synonyms: *Rhodotorula straminea* Golubev & Scorzetti, Int. J. Syst. Evol. Microbiol. 60(10): 2505 (2010), nom. inval., Art. 40.7 (Shenzhen).

*Papiliotrema aspenensis* (Ferreira-Paim et al.) Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, comb. nov. MycoBank MB831707. Basionym: Cryptococcus aspenensis Ferreira-Paim et al., PLoS ONE 9(9): e108633, 10 (2014).

Synonyms: *Papiliotrema aspenensis* (Ferreira-Paim, et al.) Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 126 (2015), nom. inval., Art. 41.5 (Shenzhen).

*Papiliotrema baii* Yurkov, M.A. Guerreiro & Á. Fonseca ex Yurkov, sp. nov. MycoBank MB831705. For description see PLoS ONE 10(4): e0126996, 15 (2015).

Holotype: PYCC 6352 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus baii Yurkov, M.A. Guerreiro & Á. Fonseca, in Yurkov et al., PLoS ONE 10(4): e0126996, 15 (2015), nom. inval., Art. 40.7 (Shenzhen).

*Papiliotrema frias* V. de Garcia, Zalar, Brizzio, Gunde-Cim. & van Brooek ex Yurkov, sp. nov. MycoBank MB831685. For description see FEMS Microbiology Ecology 82(2): 537 (2012).

Holotype: EXF-5992 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus frias V. de Garcia et al., FEMS Microbiol. Ecol. 82(2): 537 (2012), nom. inval., Art. 40.7 (Shenzhen).

*Papiliotrema hoabinhensis* D.T. Luong, M. Takash., Ty, Dung & Nakase ex Yurkov, sp. nov. MycoBank MB831686. For description see J. Gen. Appl. Microbiol. 51(6): 340 (2005).

Holotype: JCM 10835 (preserved in a metabolically inactive state).

Synonyms: *Bullera* hoabinhensis D.T. Luong et al., J. Gen. Appl. Microbiol. 51(6): 340 (2005), nom. inval., Art. 40.7 (Shenzhen).

*Papiliotrema japonica* J.P. Samp., Fonseca & Fell ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831687. For description see Int. J. Syst. Evol. Microbiol. 54(3): 990 (2004).

Holotype: CBS 2013 (preserved in a metabolically inactive state).

Synonyms: *Bullera japonica* J.P. Samp. et al., Int. J. Syst. Evol. Microbiol. 54(3): 990 (2004), nom. inval., Art. 40.6 (Shenzhen).

*Papiliotrema terrestre* Crestani, Landell, Faganello, Vainstein, Vishesiac & P. Valente ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831688. For description see Int. J. Syst. Evol. Microbiol. 59(3): 635 (2009).

Holotype: CBS 10810 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus terrestre Crestani et al., Int. J. Syst. Evol. Microbiol. 59(3): 635 (2009), nom. inval., Art. 40.7 (Shenzhen).
Papilotrema terrestris Crestani, Landell, Faganello, Vainstein, Vishniac & P. Valente ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 121 (2015), nom. inval., Art. 40.7 (Shenzhen).

Papilotrema wisconsinensis K. Sylvester, Q.M. Wang & Hittinger ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, sp. nov. MycoBank MB831712.

For description see FEMS Yeast Res. 15(3): 7 (2015).

Holotype: CBS 13895 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus wisconsinensis K. Sylvester, Q.M. Wang & Hittinger, FEMS Yeast Res. 15(3): 7 (2015), nom. inval., Art. 40.7 (Shenzhen).

= Pseudotremella lacticolour Satoh & Makimura ex Yurkov, Stud. Mycol. 81: 130 (2015), nom. inval., Art. 40.7 (Shenzhen).

Rhychogastrema complexa (Landell et al.) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, comb. nov. MycoBank MB831689.

Basionym: Bandoniozyma complexa Landell, et al., in Valente et al., PLoS ONE 7(10): e46060, 9 (2012).

Synonym: Rhychogastrema complexa (Landell, et al.) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, Stud. Mycol. 81: 127 (2015), nom. inval., Art. 41.5 (Shenzhen).

Rhychogastrema fermentans (C.F. Lee) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, comb. nov. MycoBank MB831690.

Basionym: Bandoniozyma fermentans C.F. Lee, in Valente et al., PLoS ONE 7(10): e46060, 9 (2012).

Synonym: Rhychogastrema fermentans (C.F. Lee) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, Stud. Mycol. 81: 127 (2015), nom. inval., Art. 41.5 (Shenzhen).

Rhychogastrema glucofermentans (S.O. Suh & M. Blackw.) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, comb. nov. MycoBank MB831691.

Basionym: Bandoniozyma glucofermentans S.O. Suh & M. Blackw., in Valente et al., PLoS ONE 7(10): e46060, 9 (2012).

Synonym: Rhychogastrema glucofermentans (S.O. Suh & M. Blackw.) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, Stud. Mycol. 81: 127 (2015), nom. inval., Art. 41.5 (Shenzhen).

Rhychogastrema nanyangensis F.L. Hui & Q.H. Niu ex Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, sp. nov. MycoBank MB831692.

For description see Curr. Microbiol. 65(5): 619 (2012).

Holotype: CBS 12474 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus nanyangensis F.L. Hui & Q.H. Niu, in Hui et al., Curr. Microbiol. 65(5): 619 (2012), nom. inval., Art. 40.7 (Shenzhen).

Rhychogastrema tunnelae (Boekhout, Fell, Scorza & Theelen) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, comb. nov. MycoBank MB831693.

Basionym: Bandoniozyma tunnelae Boekhout, Fell, Scorza & Theelen, in Valente et al., PLoS ONE 7(10): e46060, 9 (2012).

Synonym: Rhychogastrema tunnelae (Boekhout, Fell, Scorza & Theelen) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Yurkov, Stud. Mycol. 81: 128 (2015), nom. inval., Art. 41.5 (Shenzhen).

Rhychogastrema visegradensis (G. Péter & Dlauchy) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout & Kock, comb. nov. MycoBank MB831694.

Basionym: Bandoniozyma visegradensis G. Péter & Dlauchy, in Valente et al., PLoS ONE 7(10): e46060, 10 (2012).

Synonym: Rhychogastrema visegradensis (G. Péter & Dlauchy) Xin Zhan Liu, F.Y. Bai, M. Groenew., Boekhout &
Yurkov, Stud. Mycol. 81: 128 (2015), nom. inval., Art. 41.5 (Shenzhen).

**Ruinenia diospyri** Nakase, Tsuzuki, F.L. Lee, Jindam. & M. Takash. ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, *sp. nov.* MycoBank MB831745.

For description see J. Gen. Appl. Microbiol. 51(5): 280 (2005).

**Holotype:** JCM 12157 (preserved in a metabolically inactive state).

**Synonyms:** Sporobolomyces diospyri Nakase, Tsuzuki, F.L. Lee, Jindam. & M. Takash. J. Gen. Appl. Microbiol. 51(5): 280 (2005), as ‘diospyris’, *nom. inval.*, Art. 40.7 (Shenzhen).

= Ruinenia diospyri Nakase, Tsuzuki, F.L. Lee, Jindam. & M. Takash. ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 171 (2015), as ‘diospyris’, *nom. inval.*, Art. 40.7 (Shenzhen).

**Ruinenia pyroscias** Nakase, Tsuzuki, F.L. Lee, Jindam. & M. Takash. ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, *sp. nov.* MycoBank MB831746.

For description see J. Gen. Appl. Microbiol. 51(5): 284 (2005).

**Holotype:** JCM 12159 (preserved in a metabolically inactive state).

**Synonyms:** Sporobolomyces pyroscias Nakase, et al., J. Gen. Appl. Microbiol. 51(5): 284 (2005), *nom. inval.*, Art. 40.7 (Shenzhen).

= Ruinenia pyroscias Nakase, Tsuzuki, F.L. Lee, Jindam. & M. Takash. ex Q.M. Wang, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 171 (2015), *nom. inval.*, Art. 40.7 (Shenzhen).

**Saitozyma ninbinhensis** (D.T. Luong, M. Takash., Dung & Nakase) Yurkov, *comb. nov.* MycoBank MB831700.

For description see J. Gen. Appl. (Special Issue) Biotechnol.: 36 (2002).

**Holotype:** VTCC 10184 (preserved in a metabolically inactive state).

**Basionym:** Bulleria ninbinhensis D.T. Luong, M. Takash., Ty. Dung & Nakase, Journal of Genetics and Applications (Special Issue) Biotechnology: 36 (2002).

**Synonyms:** Saitozyma ninbinhensis D.T. Luong, M. Takash., Ty. Dung & Nakase ex Yurkov, Stud. Mycol. 81: 134 (2015), *nom. inval.*, Art. 41.5 (Shenzhen).

**Saitozyma paraflava** Golubev & J.P. Samp. ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, *sp. nov.* MycoBank MB831704.

For description see J. Gen. Appl. Microbiol. 50(2): 68 (2004).

**Holotype:** VKM Y-2923 (preserved in a metabolically inactive state).

**Synonyms:** Cryptococcus paraflavus Golubev & J.P. Samp., in Golubev et al., J. Gen. Appl. Microbiol. 50(2): 68 (2004), *nom. inval.*, Art. 40.6 (Shenzhen).

= Saitozyma paraflava Golubev & J.P. Samp. ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 134 (2015), *nom. inval.*, Art. 40.6 (Shenzhen).

**Tremella basidiomaticola** Xin Zhan Liu & F.Y. Bai, *sp. nov.* MycoBank MB831876.

For description see Mycokeys 47: 80 (2019).

**Holotype:** CGMCC 2.5724 (preserved in a metabolically inactive state).

**Synonym:** Tremella basidiomaticola Xin Zhan Liu & F.Y. Bai, Mycokeys 47: 80 (2019), *nom. inval.*, Art. 40.8 (Shenzhen).

**Trimorphomyces sakaeraticus** Fungsin, M. Takash. & Nakase ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, *sp. nov.* MycoBank MB831699.

For description see Microbiol. Culture Coll. 19(1): 37 (2003).

**Holotype:** JCM 11900 (preserved in a metabolically inactive state).

**Synonyms:** Bulleria sakaeractica Fungsin, M. Takash. & Nakase, Microbiol. Culture Coll. 19(1): 37 (2003), *nom. inval.*, Art. 40.7 (Shenzhen).

= Trimorphomyces sakaeractica Fungsin, M. Takash. & Nakase ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 134 (2015), *nom. inval.*, Art. 40.7 (Shenzhen).

**Vanrija meifongana** C.F. Lee ex Kachalkin, Yurkov & Boekhout, *sp. nov.* MycoBank MB831709.

For description see Antonie van Leeuwenhoek 99(3): 647 (2011).

**Holotype:** CBS 11424 (preserved in a metabolically inactive state).

**Synonyms:** Asterotremella meifongana C.F. Lee, in Liu et al., Antonie van Leeuwenhoek 99(3): 647 (2011), *nom. inval.*, Art. 40.7 (Shenzhen).

= Vanrija meifongana C.F. Lee ex Kachalkin, Yurkov & Boekhout, Stud. Mycol. 81: 142 (2015), *nom. inval.*, Art. 40.7 (Shenzhen).

**Vanrija nantouana** C.F. Lee ex Kachalkin, Yurkov & Boekhout, *sp. nov.* MycoBank MB831710.

For description see Antonie van Leeuwenhoek 99(3): 648 (2011).

**Holotype:** CBS 10890 (preserved in a metabolically inactive state).

**Synonyms:** Asterotremella nantouana C.F. Lee, Antonie van Leeuwenhoek 99(3): 648 (2011), *nom. inval.*, Art. 40.7 (Shenzhen).

= Vanrija nantouana C.F. Lee ex Kachalkin, Yurkov & Boekhout, Stud. Mycol. 81: 142 (2015), *nom. inval.*, Art. 40.7 (Shenzhen).

**Vanrija thermophila** Vogelmann, S. Chaves & C. Hertel ex Kachalkin, Yurkov & Boekhout, *sp. nov.* MycoBank MB831711.

For description see Int. J. Syst. Evol. Microbiol. 62(7): 1719 (2012).

**Holotype:** CBS 10687 (preserved in a metabolically inactive state).

**Synonyms:** Cryptococcus thermophilus Vogelmann, S. Chaves & C. Hertel, Int. J. Syst. Evol. Microbiol. 62(7): 1719 (2012), *nom. inval.*, Art. 40.7 (Shenzhen).

= Vanrija thermophila Vogelmann, S. Chaves & C. Hertel ex Kachalkin, Yurkov & Boekhout, Stud. Mycol. 81: 142 (2015), *nom. inval.*, Art. 40.7 (Shenzhen).

**Vishniacozyma follicola** Q.M. Wang & F.Y. Bai ex Yurkov, *sp. nov.* MycoBank MB831680.

For description see J. Gen. Appl. Microbiol. 57(5): 287 (2011).

**Holotype:** CGMC AS 2.2471 (preserved in a metabolically inactive state).

**Synonyms:** Cryptococcus follicoli Wang & F.Y. Bai, J. Gen. Appl. Microbiol. 57(5): 287 (2011), *nom. inval.*, Art. 40.7 (Shenzhen).

= Vishniacozyma follicola Q.M. Wang & F.Y. Bai ex Yurkov, Stud. Mycol. 81: 124 (2015), *nom. inval.*, Art. 40.7 (Shenzhen).

**Vishniacozyma heimaeyensis** Vishniac ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, *sp. nov.* MycoBank MB831682.

For description see Canad. J. Microbiol. 48(5): 464 (2002).

**Holotype:** CBS 8933 (preserved in a metabolically inactive state).

**Synonyms:** Cryptococcus heimaeyensis Vishniac, Canad. J. Microbiol. 48(5): 464 (2002), *nom. inval.*, Art. 40.7 (Shenzhen).

= Vishniacozyma follicola Vishniac ex Xin Zhan Liu, F.Y. Bai, M. Groenew. & Boekhout, Stud. Mycol. 81: 124 (2015), *nom. inval.*, Art. 40.6 (Shenzhen).

**Vishniacozyma psychrotolerans** V. de Garcia, Zalar, Brizzi, Gunde-Cim. & Van Broock ex Yurkov, *sp. nov.* MycoBank MB831684.
For description see FEMS Microbiology Ecology 82(2): 535 (2012).

Holotype: EXF-7039 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus psychrotolerans V. de Garcia, Zalar, Brizzio, Gunde-Cim. & Van Broock, FEMS Microbiol. Ecol. 82(2): 535 (2012), nom. inval., Art. 40.7 (Shenzhen).

= Vishniacozyma psychrotolerans V. de Garcia, Zalar, Brizzio, Gunde-Cim. & Van Broock ex Yurkov, Stud. Mycol. 81: 124 (2015), nom. inval., Art. 40.7 (Shenzhen).

Vishniacozyma taibaensis Q.M. Wang & F.Y. Bai ex Yurkov, sp. nov. MycoBank MB831681.

For description see J. Gen. Appl. Microbiol. 57(5): 288 (2011).

Holotype: CBS 8935 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus taibaiensis Q.M. Wang & F.Y. Bai, J. Gen. Appl. Microbiol. 57(5): 288 (2011), nom. inval., Art. 40.7 (Shenzhen).

= Vishniacozyma taibaensis Q.M. Wang & F.Y. Bai ex Yurkov, Stud. Mycol. 81: 124 (2015), nom. inval., Art. 40.7 (Shenzhen).

Vishniacozyma tephrensis Vishniac ex Xin Zhan Liu, F.Y. Bai, M. Groeneuw. & Boekhout, sp. nov. MycoBank MB831683.

For description see Canad. J. Microbiol. 48(5): 466 (2002).

Holotype: CBS 10977 (preserved in a metabolically inactive state).

Synonyms: Cryptococcus tephrensis Vishniac, Canad. J. Microbiol. 48(5): 466 (2002), nom. inval., Art. 40.6 (Shenzhen).

= Vishniacozyma tephrensis Vishniac ex Xin Zhan Liu, F.Y. Bai, M. Groeneuw. & Boekhout, Stud. Mycol. 81: 124 (2015), nom. inval., Art. 40.6 (Shenzhen).

Yamadamyces Q.M. Wang, F.Y. Bai, M. Groeneuw. & Boekhout, gen. nov. MycoBank MB831747.

For description see Stud. Mycol. 81: 178 (2015).

Type species: Yamadamyces rosulatus Golubev & Scorzetti ex Q.M. Wang, F.Y. Bai, M. Groeneuw. & Boekhout.

Synonym: Yamadamyces Q.M. Wang, F.Y. Bai, M. Groeneuw. & Boekhout, Stud. Mycol. 81: 178 (2015), nom. inval., Art. 40.1 (Shenzhen).

Yamadamyces rosulatus Golubev & Scorzetti ex Q.M. Wang, F.Y. Bai, M. Groeneuw. & Boekhout, sp. nov. MycoBank MB831748.

For description see Int. J. Syst. Evol. Microbiol. 60(10): 2503 (2010).

Holotype: CBS 10977 (preserved in a metabolically inactive state).

Synonym: Rhodotorula rosulata Golubev & Scorzetti, Int. J. Syst. Evol. Microbiol. 60(10): 2503 (2010), nom. inval., Art. 40.7 (Shenzhen).

= Yamadamyces rosulatus Golubev & Scorzetti ex Q.M. Wang, F.Y. Bai, M. Groeneuw. & Boekhout, Stud. Mycol. 81: 178 (2015), nom. inval., Art. 40.7 (Shenzhen).

CONTRIBUTIONS

F.-Y.B. and Q.-M.W. conceived and designed the project. Q.-M.W., F.-Y.B., P.-J.H. and L.-D. G. performed sampling and yeast isolation. A.-H. Li, F.-X.Y. and Q.-M.W. performed phenotypic characterisation and analysed the molecular data. L.K. run the emboss water analysis. A.Y. analysed the D1/D2 data. K.B. registered the taxa in MycoBank and handled the invalid taxonomic names. Q.-M.W., M.G. and F.-Y.B. wrote the paper. Q.-M.W., M.C.A., A.Y. and K.B. revised the paper. A.Y., M.T., J.P.S., B.F., S.J., M.C.A., B.T., J.I. supported the sequences and physiological data or strains generated and conserved in their laboratory.

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APPENDIX A. SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.simyco.2020.01.002.

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