

## Present state, modern methods and perspectives in penicillium study

Abstracts from the Penicillium Seminar,  
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The seminar was held by Czech Scientific Society for Mycology, Division of Micromycetes. At this one-day regional seminar ten Czech and Slovak scientists presented the papers cited below. The proceedings (in Czech with English abstracts) of "Present State, Modern Methods and Perspectives in Penicillium Study" are available at the secretary of the Division of Micromycetes: K. Prášil, Department of Botany, Faculty of Natural Sciences, Charles University, Benátská 2, 128 01 Praha 2, Czech Republic.

### Study of the genus *Penicillium* – history and new approaches

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The history of the study of *Penicillium* is presented. Study of herbarium specimens during the 19th century was followed by culture techniques (Brefeld, Dierckx, Sopp, Bainier, Westling, Biourge, Zaleski). A very important manual of penicillia was prepared by Raper and Thom (1949). The morphological taxonomic base was broadened by Abe (1956) using some physiological characters. The nomenclatural and taxonomic problems connected with Raper's and Thom's approach were resolved by Pitt (1979) and other taxonomists. Nevertheless, the problem of a species concept was not cleared. Great progress has been made from the 1980s. A multidisciplinary study of terverticillate penicillia started at CMI in Kew. The computer assisted key PENIMAT was developed. Frisvad and collaborators broadened the taxonomic base by adding other physiological characters and profiles of secondary metabolites. Collaborative studies on the international level were achieved. At the present time the taxonomic value of new biochemical and genetic methods is investigated. The current situation seems to lead towards a stability of names.

### Nomen conservandum in the genus *Penicillium*

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During the workshop in Baarn (The Netherlands) in the year 1989 the specialists of the genus *Penicillium* and *Aspergillus* have designated the name *Penicillium*

*chrysogenum* Thom as nomen conservandum in view of its historic and economic importance. Otherwise, *Penicillium chrysogenum* ought to be classified as a synonym of the species *Penicillium griseoroseum* Dierckx.

### Species concept in some *Penicillium* species

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The present species concept of some penicillia different from those of Pitt (1979) is discussed. Attention is paid to the paper of Pitt et al. (1990) dealing with closely related species *P. glabrum* (syn. *P. frequentans*), *P. spinulosum*, *P. purpurescens* and *P. montanense*. The present position of *P. janczewskii* (syn. *P. nigricans*) and *P. albidum* (nomen dubium) is pointed out. Some Czech isolates of "*P. albidum*" were re-identified as *P. janczewskii* and *P. daleae*. The species concept of *P. simplicissimum*, *P. brasilianum* and *P. janthinellum* is presented and compared with literature. The present species concept of *P. miczynskii*, *P. soppii* and *P. manginii* is discussed. Changes in the species concept of terverticillate penicillia are demonstrated (*P. aurantiogriseum*, *P. verrucosum*, *P. solitum*, *P. commune* etc.). The position of the species *P. minioluteum* is mentioned.

### Study of the genus *Penicillium* in the Czech and Slovak Republics and survey of reported species

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Three lists of penicillia and associated teleomorphs reported from the Czech and Slovak Republics with their bibliography are presented.

The first list contains the findings of penicillia and teleomorphs from soils: 85 *Penicillium* species names in current use, 9 species of the genus *Talaromyces*, 6 species of the genus *Eupenicillium*, and other names of uncertain application. The most frequent species from soils appear to be *P. albidum*, *P. aurantiogriseum*, *P. brevicompactum*, *P. camembertii*, *P. canescens*, *P. chrysogenum*, *P. citrinum*, *P. commune*, *P. expansum*, *P. glabrum*, *P. janczewskii*, *P. purpurogenum*, *P. restrictum*, *P. rugulosum*, *P. simplicissimum*, *P. spinulosum*, and *P. variabile*. On

the other hand, *P. adametzii*, *P. arenicola*, *P. brasilianum*, *P. capsulatum*, *P. coprophilum*, *P. cyaneum*, *P. hordei*, *P. italicum*, *P. megasporum*, *P. rubefaciens*, *P. digitatum*, *P. nalgiovense*, *P. islandicum*, *P. scabrosum* and *P. soppii* were rarely isolated from soils. *P. brasilianum*, *P. italicum* and *P. melinii* represent species with an interesting occurrence.

The second list contains findings from other substrates (e.g. air, foods, feeds, etc.): 78 *Penicillium* names in current use, 6 species of *Eupenicillium*, 5 species of *Talaromyces*, several findings of other genera and other names of uncertain application. The most frequent species are the following: *P. chrysogenum*, *P. aurantiogriseum*, *P. expansum*, *P. glabrum*, *P. brevicompactum*, *P. citrinum*, *P. viridicatum*, *P. purpurogenum*, *P. variable*, and *P. janthinellum*. The following penicillia were recorded rarely: *E. crustaceum* (as *P. asperum*), *E. lapidosum* (as *P. lapidosum*), *E. ochrosalmoneum* (as *P. ochrosalmoneum*), *P. bilaiae*, *P. brasilianum*, *P. manginii* (as *P. atrosanguineum*), *P. melinii*, *P. piscarium*, *P. resedanum*, *P. sublateritium*, and *P. westlingii*. The first published find from this area is *P. expansum* by Opiz (1823). The oldest illustration of *Penicillium* species is probably that by Corda (1839), which represents *P. fieberi*.

A list of all *Penicillium* species finds including synonyms is added. Altogether 91 *Penicillium* species names in current use, 11 species of *Eupenicillium*, and 9 species of *Talaromyces* were recorded from the Czech and Slovak Republics.

### Some rare penicillia and related genera

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The macro- and micromorphology of *Penicillium arenicola*, *P. brunneum*, *P. dupontii*, *P. inflatum*, *P. islandicum*, *P. minioluteum* and *P. olsonii* is briefly described. Differences between *Aspergillus*, *Eladia* (*E. saccula*), *Geosmithia* (*G. cylindrospora*, *G. emersonii*), *Gliocladium*, *Merimbla* (*M. ingelheimensis*), *Metarrhizium*, *Paecilomyces*, *Phialocephala*, *Scopulariopsis* and *Thysanophora* against *Penicillium* are pointed out.

### Identification of *Penicillium* species using the production of mycotoxins

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*Penicillium* is a widely distributed genus represented by more than 300 different species. A good guide for the difficult identification of *Penicillium* species and for

the assessment of the risk of their appearance is the production of mycotoxins. The method is illustrated by results of the monitoring of the *Penicillium* genus in the working environment of the Příbram uran mine. In 70 swabs of the workplace and 116 laryngeal swabs of miners 103 different penicillia belonging to 26 species were found. In 57 isolates the production of mycotoxins was found in liquid medium, as identified by thin layer chromatography (brevianamide A, citreoviridin, citrinin, curvularin, carolic acid, griseofulvin, chaetoglobosin A, mycophenolic acid, secalonic acid D, patulin, penicillic acid, rugulosin, xanthomegnin and viomellein). Chloroform extracts of 18 penicillia were toxic for 42 hours old chick embryos. However, toxic metabolites were not identified. The production of mycotoxins different from literature data was found in the case of *P. aurantiogriseum* (chaetoglobosin A), 7 isolates of *P. fellutanum* (carolic acid) and 15 isolates of *Penicillium* spp. (curvularin).

### The genus *Penicillium* in the pathogenesis of some respiratory diseases

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As we have determined during 30 years investigation of patients from agriculture and different industries, many species of the genus *Penicillium* take part in the pathogenesis of some respiratory diseases (bronchitis, bronchial asthma, the farmer's lung syndrom) in our countries .

The sources were found partly in penicillia occurring out-doors, in-doors, on walls and objects of rooms (which was studied daily during 3 years), partly in penicillia occurring on the mucous membranes of men. *Penicillium decumbens* dominates in this study.

*Penicillia* has prevailed in previous years, especially in bronchial asthma, later in immunocompromised patients. The participation of penicillia in the pathogenesis of these diseases was verified partly according to immunological reactivity of patients, partly in experiments on rabbits. After the inhalation of hay particules contaminated by *P. decumbens*, severe bronchopneumonia accompanied by high levels of specific antibodies, as well as by allergic necrotising vasculitis, was developed in experimental animals.

For this reason we suppose that some species of the genus *Penicillium* should be considered as opportunistic pathogens.

However, there is also one strictly pathogenic species in the genus *Penicillium*, the dimorphic *P. marneffeii*, which is endemic in Southeast Asia. It has been recognised since 1973 as an agent of natural infections among immunocompromised patients travelling in Southeast Asia. It evokes a very severe disseminated, mostly

fatal disease, resembling disseminated histoplasmosis. This *Penicilliosis marneffeii* must be included in the clinical definition of AIDS, like other systemic mycoses (histoplasmosis, cryptococcosis, coccidioidomycosis) in defined endemic areas.

#### Some teleomorphs of *Penicillium* sp., their heat-resistance, occurrence and importance

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The paper deals with the modern taxonomy, occurrence and heat-resistance of *Penicillium* sp. which were introduced as *Penicillium vermiculatum*, *P. bacillosporium*, *P. avellaneum* and *P. baarnense* in the monography of Raper and Thom (1949). These species are new heat-resistant ones and the strains were isolated from soil. Heat-resistant fungi are a subject for scientific investigation.

#### Human illnesses caused by toxins of *Penicillium* species

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Acute cardiac beri-beri is certainly caused by citreoviridin, the mycotoxin of *Penicillium citreoviride*. The significance of *Penicillium* mycotoxins in the ethiology of toxic hepatitis, pulmonary mycotoxicosis, Balcan endemic nephropathy, Danish nephropathy and some human tumors is probable, but not definitely demonstrated. The possible significance of cyclopiazonic acid in the ethiology of Reye's syndrome in sucklings is discussed.