

## BOOK REVIEW

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***Penicillium* subgenus *Penicillium*: new taxonomic schemes  
and mycotoxins and other extrolites**

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One of the first species to be described in *Penicillium* was *P. expansum*, a species producing terverticillate smooth-walled penicilli, synnemata, and capable of producing rot in apples. The mycologist who first described this species was the German scientist Johann H.F. Link (1767–1851), professor of Botany in Rostock, Breslau and Berlin. The description appeared in 1809 in a journal published in Berlin.

It has to be remembered that the taxonomy of Penicillia constitutes an important chapter, and the teacher of the reviewer, Professor Karol Zaleski (1890–1969), published a list of 36 new species of Penicillia in 1928. They were isolated from soils in different parts of Poland. After 72 years, in 2000, 12 species identified by K. Zaleski were accepted by J.I. Pitt, R.A. Samson, and J.C. Frisvad, in the book “Integration of Modern Taxonomic Methods for *Penicillium* and *Aspergillus* classification”.

In 1988 J. I. Pitt wrote that *Penicillium* is not easy to identify. It is a large genus, with at least 150, and perhaps even 300 species. So many of them look alike to the unidentified. There is a great deal of variability within these species. According to the opinion of J. I. Pitt at least 1000 recognisably different phenotypes will eventually be catalogued. For at least 25 years the types of conidiophore distinct branching have been established, for simplicity one-stage branched (= biverticillate), two-stage branched (= terverticillate) and three-stage branched (quarter-verticillate).

The reviewed studies include four chapters, *i.e.*:

- polyphasic taxonomy of *Penicillium* subgenus *Penicillium*; a guide to identification of food and airborne terverticillate Penicillia and their mycotoxins;
- phylogenetic analysis of *Penicillium* subgenus using partial  $\beta$ -tubulin;
- mycotoxins, drugs and other extrolites produced by species of *Penicillium* subgenus *Penicillium*;
- classification of terverticillate Penicillia by electrospray mass spectrometric profiling.

J. C. Frisvad and R. A. Samson propose for the first time a stable taxonomy of 58 species. Four new species *i.e.* *P. cavernicola*, *P. frei*, *P. marinum* and *P. thymicola* are described and two new combinations are made – *P. melanoconidium* and *P. neoechinulatum*. Some species with terverticillate penicilli, or rather twice biverticillate penicilli, including *P. arenicola* (Chalab, 1950), *P. scabrosum* (Frisvad *et al.*, 1990), *P. fennelliae* (Stolk, 1969) and *P. lanosum* (Westling, 1911) are not treated in the reviewed book, being regarded as phylogenetically and phenetically unrelated soil-borne forms.

The reviewed study is a strong basis for the identification of the 58 species of *Penicillium* subgenus *Penicillium*. It must be explained to the Polish mycologists that the identification of Penicillia, even by using the seventh edition of the book “Introduction to food- and airborne fungi” is insufficient. The new book provides phenotypic characters including micro- and macromorphology, physiology, growth at 5, 15, 25, 30, 37°C, growth at 5% NaCl and 15% sucrose. The most important statement of J.C. Frisvad and R.A. Samson is, that the profiles of secondary metabolites are highly species-specific.

It may be of interest to the Polish reader that among 58 species of *Penicillium* subgenus *Penicillium*, there are two Polish taxa established in 1927 by Karol Zaleski, *i.e.* *P. bialowiezense* (K. Zaleski) and *P. polonicum* (K. Zaleski). The first one was found in Denmark, Faroe Islands, Poland, Italy, Slovenia, Chile, Wyoming, USA, Canada and Saudi-Arabia. The second one was found in Denmark, Sweden, United

Kingdom, Germany, the Netherlands, Spain, Italy, Canada, Kenya and Taiwan. Both species are typical cultures in the main culture collections all over the world.

Partial  $\beta$ -tubulin sequences were determined for 180 strains, representing all accepted species of *Penicillium* subgenus *Penicillium*. It was found that  $\beta$ -tubulin sequences were excellent species markers, correlating well with phenotypic characters.

For the first time all mycotoxins, drugs and other extrolites have been listed in 58 described species of *Penicillia*. Every extrolite (secondary metabolite) is identified by the producer. The included table presents the list of all incorrectly identified or unidentified producers. 132 extrolites are reported from the subgenus, with the average of five extrolite families per species.

The review of chemotaxonomic study of the terverticillate *Penicillia* since 1980 has been provided. The presented classification of terverticillate *Penicillia* is based on 429 isolates of 58 species described in the book. The study shows that about 70% of the species can be classified into species, using only the analysis of metabolites produced on one growth medium.

One must only congratulate all the authors of the reviewed book and recommend libraries of universities and research institutions to purchase the book as soon as possible. This will provide a giant step forward in advancing the knowledge of the taxonomy of *Penicillia* in Poland.

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