SPECIFIC MYCOTOXIN PRODUCING PENICILLIUM AND ASPERGILLUS MYCOFLORA OF DIFFERENT FOODS.

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Penicillium and Aspergillus species are very common in stored foods (ref. 1) and they produce a large number of mycotoxins. Isolates of these genera are also very important producers of mycotoxins, and they are also very important producers of enzymes, organic acids etc. A very high number of mycotoxins are known (ref. 2-3) and it would be impossible to analyze all foods and industrial products for all known toxins. The proposed clear connection between fungal species and profiles of secondary metabolites (ref. 4-5) and the connection between foods and their mycoflora at different environmental conditions has been somewhat obscured by different taxonomic systems and misidentifications (ref. 6), especially in the genus Penicillium. We have gathered data on profiles of secondary metabolites in Penicillium and Aspergillus (ref. 4-6) and on the mycoflora of different foods (ref. 7) and the most important results are summarized below.

SPECIFIC PROFILES OF MYCOTOXINS IN PENICILLIUM AND ASPERGILLUS

The specific profiles of mycotoxins produced by different Penicillium and Aspergillus species has been listed in ref. 4-7. The connection between species and mycotoxin production is quite clear in Aspergillus species, even though few wrong connections have been reported repeatedly. Thus A. versicolor does not produce cyclopiazonic acid and A. niveus or A. candidus does not produce citrinin (ref. 6).

Compared to Aspergillus species, the connection between taxa and

toxins in Penicillium is less clear, mainly because of the different species concepts in ref. 8-10, but also because of a quite high number of misidentified mycotoxin producers (ref. 6). This is most pronounced in species previously called P. cyclopium and P. viridicatum (ref. 8) or P. verrucosum var. cyclopium or var. verrucosum (ref. 9). Based on physiological characters and profiles of secondary metabolites these taxa were reclassified in 1981-83 (ref. 4 and 11) although sometimes under provisional experimental names. Four to six years later other taxonomists agreed that these species were "correct" (ref. 12-13). Table 1

Table 1. A new classification of taxa previously called P. cyclopium, P. viridicatum or P. verrucosum based on profiles of secondary metabolites and physiological criteria.

Ref. 11	Ref. 4	Ref. 5-6, 12-13
" <u>P. cyclopium</u> p"	<u>P. aurantiogriseum</u> <u>P. viridicatum</u> I	<u>P. aurantiogriseum</u> (<u>P. viridicatum</u>)
" <u>P. viridicatum</u> o-c"	<u>P. viridicatum</u> II + III	<u>P. verrucosum</u>
<u>P. crustosum</u>	<u>P. crustosum</u>	<u>P. crustosum</u>
" <u>P. melanochlorum</u> "	<u>P. mali</u>	<u>P. solitum</u>
" <u>P. caseiphilum</u> "	<u>P. camemberti</u> II	<u>P. commune</u>
Not examined	<u>P. viridicatum</u> IV	<u>P. aethiopicum</u>

lists these names and their previous designations. Table 1 is of particular value because we can use data obtained on the mycoflora of foods examined in our lab during the last 15 years and allocate "correct" species to their proper food items.

SPECIFIC MYCOFLORA OF DIFFERENT FOODS

Our experience has been that different kinds of foods each have a specific profile of spoilage fungi (i.e. mycoflora) under normal conditions, that is the composition of the substrate (high or low levels of lipids, proteins, carbohydrates etc.) and the chemical defence systems of living plants and animals are the selective factors. When environmental factors become more extreme (such as a lower water activity, a high storage temperature, presence of a preservative at low pH values etc.) the chemical defence systems of plants are less effective (or not effective at

all) and the kind of food will be less important than the "extreme" environmental factor(s). Some of the most important penicillia and aspergilli which will grow under more extreme conditions are listed below.

At low temperatures most terverticillate penicillia (and P. glabrum) will grow excellent, especially P. aurantiogriseum and P. verrucosum. Many aspergilli will grow at higher storage temperatures, f. ex. A. flavus, A. candidus, A. terreus and Emericella nidulans, while A. clavatus and A. fumigatus will grow at very high storage temperatures (in malting barley f.ex.). Occasionally penicillia, such as P. oxalicum and species in the teleomorphic states of Penicillium: Talaromyces and Eupenicillium will grow in foods stored at high temperatures.

Species that grow particularly well at low water activities include A. restrictus, A. penicilloides, Eurotium spp., A. candidus, P. corylophilum, P. chrysogenum and P. brevicompactum and the growth of these species will promote growth of other less xerophilic penicillia and aspergilli.

A. candidus, A. flavus, P. roqueforti, P. glabrum and P. funiculosum grow well at low pH values and the three former species are also preservative resistant (towards formic and propionic acid). Isolates of P. roqueforti, P. commune, P. solitum and P. crustosum are often resistant towards benzoic and sorbic acid.

A number of penicillia and aspergilli are able to grow at very low oxygen tensions: P. roqueforti, P. glandicola, P. vulpinum, P. coprophilum, P. glabrum, A. terreus, and Neosartorya, Talaromyces and Eupenicillium species. These species may therefore be found in carbonated beverages, drinking water etc.

Species occurring in pasteurized foods include Talaromyces macrosporus, Eupenicillium lapidosum and Neosartorya fischeri, because of their heat resistant ascospores.

Fungi growing on cereals in temperate regions of the world are P. aurantiogriseum, P. verrucosum and P. hordei, whereas P. aurantiogriseum (including P. viridicatum) and P. aethiopicum are more prevalent in tropical countries. A. flavus and A. niger are also important on cereals, but these two species are very common on all kinds of foods. A. niger is much more prevalent on fruit-

products and vegetables than A. flavus, however.

The penicillia occurring on nuts are different from those found on cereals: P. crustosum, P. commune, P. solitum, P. echinulatum, P. expansum, P. brevicompactum, P. glabrum, P. citrinum and P. fellutanum are often found actively growing.

P. expansum, P. crustosum, P. solitum, P. glabrum, P. thomii and P. hirsutum are important species on fruits and vegetables while P. brevicompactum is the only Penicillium species recovered from fleshy fungi. Other penicillia, P. islandicum, P. citrinum, P. purpurogenum and P. olsonii are important on spices and herbs.

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