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## Editorial overview: Food mycology

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Russell Paterson undertook his PhD in Chemistry at the University of Manchester, UK, under the supervision of J. D. Bu'Lock, of fungal secondary metabolism/mycotoxin fame. He undertook a 2.5-year postdoctoral appointment at the Boyce Thompson Institute at Cornell University, New York, USA. Dr Paterson was employed at the international non-governmental organisation, CABI, UK where he was the Senior Scientist researching fungal natural products, including mycotoxins. He was awarded the IOI Professorial Chair in Plant Pathology at the Universiti Putra Malaysia, Malaysia in 2008. Currently, he is employed as a researcher at the Centre for Biological Engineering, University of Minho, Portugal, and teaches on food mycology courses. Running international training courses on food mycology are included in his competencies, and he has travelled widely for this purpose. Editorial roles have included coordinating editor of *Mycopathologia*, and he is an editor of *Current Enzyme Inhibition*, *Journal of Earth Science & Climatic Change*, and *Current Opinion in Food Science*. He has written numerous papers, books and chapters on aspects of fungal secondary metabolism, including mycotoxins. A special award was presented to him at the World Nutrition Forum, Singapore in 2012 for his work on mycotoxins and climate change and he was the editor of a special issue on the fungus *Ganoderma* for *Phytochemistry* in 2015. His total publications number are c. 210.

Food mycology has expanded beyond recognition over the past 10 years. The field of study is now considered in its own right rather than an offshoot of food microbiology. I am discussing here the subject in terms of biodeterioration rather than the use of fungi to produce food. Also, the special issue (SI) considers filamentous fungi (ff) but not yeasts, although these are very important.

The reason that this aspect of food mycology has become so relevant is because of the increased awareness of (a) mycotoxins, these poisonous low molecular weight compounds that are produced by ff and contaminate food; (b) the effects of climate change (CC) and (c) the public's concern for food safety and wastage. Mycotoxins cause such concern because of reported illness and deaths in humans and animals and that some have statutory limits imposed on them by regulatory organisations such as the EU and FDA. This is in contrast to the situation with the ff which have no set limits. However, mouldy bread or cakes are frequently returned to shops by anxious consumers, and whole “shiploads” of grains can be rejected at immigration ports, causing huge economic loss. Any signs of fungal growth on foods are immediately noticed and reported.

A surprising factor is how the taxonomy of ff that causes problems in food remains unsatisfactory. Previously accepted single species are being shown to contain many and in other cases, numerous different species can be revised to a low number of taxa. There remain many misidentifications within the literature. The production of mycotoxins from ff not normally considered to produce them is still reported and confounds our understanding of fungal chemotaxonomy.

There remain few methods that accurately enumerate ff. After all, what is a single colony? Is it a conidium, a hypha, a conidiophore, or has a combination of these initiated a colony on an agar plate? A useful aspect of mycotoxin analysis is that fully quantitative methods are available which can be effectively a historical identification of FF that are, or were, present at some stage in the life of a commodity.

Originally, I wanted to make this SI broader — a combination of paper attrition rate and restrictions on time, made the actual papers published more selective. So let us consider them: The SI starts sensibly with a discussion on how even the nomenclature of fungi requires revision ([Hawksworth \[1\]](#)) because diverse morphs of a single pleomorphic species can no longer have different scientific names. This is followed by a general opinion paper that warns of the dangers of mutagens affecting FF which could influence preservation, taxonomy, biodiversity estimations, mycotoxin

determinations from strains, and general studies on the physiology of these organisms (Paterson and Lima [2]). An issue which nobody can ignore is that of CC. This deserves special mention and is dealt with by (Medina, Rodríguez and Magan [3]) who detail the effect on mycotoxins in commodities where it has become accepted that mycotoxins are likely to increase in some cases. Many physiological factors require consideration to assess the true effect of CC as is discussed. We then move naturally on how to quantify fungi (Rodríguez *et al.* [4]) without resorting to colony forming units with their inherent inaccuracies. This paper does focus on molecular DNA procedures but those such as MALDI TOF are considered. The novel method of loop-mediated isothermal amplification still has to overcome the problem of enzyme inhibition and requires a consideration of internal implication controls as for conventional PCR. These papers are followed by aspects involving specific mycotoxins.

The first paper in this section considers the important area of aflatoxins and how to degrade them (Baranyi *et al.* [5]). The authors mention the potential for production of aflatoxins in drinking water and discuss how CC is allowing these dangerous compounds to be reported from non tropical countries such as in central Europe. The next mycotoxin-based paper is by Nagl and Schatzmayr [6] in relation to the *Fusarium* mycotoxin deoxynivalenol (DON). These authors discuss the important masked mycotoxins, in this case deoxynivalenol-3- $\beta$ -D-glucoside, which when cleaved, may increase the mycotoxin load on mammals, although would not be detected in food by current methods. Interestingly, a strain of a new bacterial species from the *Coriobacteriaceae* has gained EU approval for detoxifying DON. The low molecular weight mycotoxin patulin produced by,

*inter alia*, *Penicillium expansum* is also discussed (Wright [7]). The first gene probe for a mycotoxin was developed for patulin and further molecular developments are reported. There is much more information on patulin producing fungi being isolated from apple cores, providing an indication of why apple juice can contain patulin despite being produced from perfect-looking apples. A novel potential source of patulin from shellfish is mentioned and biocontrol methods for patulin and producing fungi are reported.

In conclusion, I have produced a select collection of papers related to food mycology as defined herein by some very prominent authors. My gratitude is extended to them. Our thanks also go to the publishers for their perseverance and professionalism.

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