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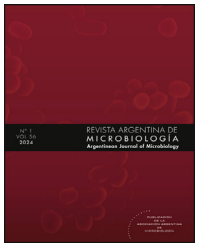

EDITORIAL

Future challenges in food mycology – food spoilage, safety and security

Futuros desafíos en micología de los alimentos, deterioro, inocuidad y seguridad

A large share of the world's food supply is at risk of fungal deterioration both before and after harvest. In 2015, the United Nations set sustainable development goals that prioritize reducing food waste, with the target of halving *per capita* waste by 2030 and minimizing losses along the production chain, including post-harvest stages. This has drawn attention towards tackling food waste. Fungal contamination not only lowers crop yields and causes spoilage, but may also lead to mycotoxin contamination, posing serious threats to food safety and security.[2] At the same time, fungi also positively contribute to food production, for example, through fermentation and alternative protein production, making them part of sustainable food solutions.[5]

Every three years, the International Commission on Food Mycology (IUMS, ICFM) organizes a workshop, and its 11th edition was held from 7 to 9 July, 2025 at the Westerdijk Fungal Biodiversity Institute in Utrecht, the Netherlands. The workshop was jointly organized with the International Commission on *Penicillium* and *Aspergillus* (IUMS, ICPA), with the participation of food mycologists from 33 countries, either onsite or online. The participants came from academia, research institutes, and companies, and were also at different stages of their careers. At the ICFM workshops, the aim is to give all participants, the opportunity to present their data. This also makes the workshop an excellent opportunity for early-career scientists to share their work and build their network within food mycology. At ICFM2025, travel grants and/or registration fees were waived for selected (online) participants, enabling broader participation in the workshop. The organizers encouraged interaction among participants, even outside the scientific program. Taken together, the various backgrounds and expertise of the participants led to interesting discussions, not only of scientific data, but also of how these data are interpreted in practical contexts. Hopefully, the ICFM workshop also helped establish new connections.

The focus of the ICFM2025 workshop was on food spoilage and food safety. It also explored the positive aspects of fungi and food. The program was structured around five themes:[3]

(1) *Food spoilage reduction*. In the sessions of food spoilage prevention, presentations were given on well-known preservatives (*e.g.*, weak organic acids), and also on novel natural preservatives and biocontrol organisms such as lactobacilli, with applications in dairy and bakery products. Technologies such as UV radiation, modified atmosphere packaging, and pasteurization help to reduce spoilage, but challenges using these technologies still remain. A key insight was the need to balance spoilage control, safety, and sustainability in food processing.
(2) *Ecology of mycotoxigenic fungi, incidence of mycotoxin contamination, and associated exposure risks*. The presentations highlighted the fact that mycotoxin contamination in foods remains a significant concern. Data were presented across a variety of foods, ranging from artisanal cheeses to coffee, moldy foods at the household level, and plant-based protein sources such as lupin beans. This emphasized the importance of understanding the mycobiota associated with less-studied foods and their correlation with mycotoxin production. Additionally, climate change was shown to influence fungal growth and mycotoxin formation. For example, in Robusta coffee, biocontrol strategies are being developed to prevent ochratoxin A accumulation under predicted climate scenarios.
(3) *Fungi for alternative proteins and in fermentation*. Alternative proteins and fermentation are receiving increasing attention due to their roles in food security and sustainability. During the workshop, data were presented on developing improved *Fusarium venenatum* strains for mycoprotein production, focusing on

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traits such as protein content, texture, and mycotoxin safety. In addition, there were discussions on plant-based cheese analogues produced using *Penicillium roqueforti* and *Penicillium camemberti*, species that are also used in conventional cheese production. These presentations highlighted both the opportunities and challenges involved in scaling up sustainable fungal-based food production.

(4) *Methodology development and standardization*. Recent advances in food mycology have focused on the reliable detection and identification of spoilage and mycotoxin-producing fungi. In this session, a presentation highlighted the use of genome sequencing of *Penicillium* strains to trace contamination sources in production facilities. Interim results of MALDI-TOF MS, a proteomics technique commonly used in clinical settings and bacterial or yeast identification, demonstrated that optimized sample preparation is crucial for accurately identifying filamentous fungi such as *Alternaria*, *Cladosporium*, and *Fusarium*. Furthermore, hyperspectral imaging showed promise as a non-invasive method for the early detection of *Alternaria tenuissima* in apples, and for predicting associated mycotoxin accumulation. The discussion emphasized the need for standardized protocols to ensure reproducibility and practical application.

(5) *New taxonomic insights in mycotoxigenic fungi (in collaboration with ICPA)*. Accurate identification of food-associated fungi is crucial for addressing spoilage and mycotoxin risks. In one of the presentations, the taxonomy of *A. flavus* and its domesticated counterpart *A. oryzae* was discussed. While genome sequencing often struggles to distinguish closely related species such as *A. oryzae* and *A. flavus*, phenotypic and chemotaxonomic methods remain effective and necessary. Advances in DNA barcoding and polyphasic taxonomy have contributed to a better understanding of the mycotoxigenic genera *Aspergillus*, *Fusarium*, *Penicillium*, and *Talaromyces*, leading to clearer species boundaries and identification guidelines. Workshop discussions indicated that *Alternaria* taxonomy still needs improved taxonomic schemes to enhance strain identification, highlighting a priority area for future research.

During 2022–2025, the ICFM had 20 members, who gathered at the workshop. Sofia N. Chulze, Ludwig Niessen, and F. Javier C. Cabañes announced that they were stepping down from the ICFM. Their contributions were acknowledged, and the addition of new members ensures continuity as well as new perspectives. They will be succeeded by Maria Laura Ramirez (Argentina) and Gemma Castellá (Spain), and the ICFM looks forward to collaborating with these new members in the future.

Food mycology remains a dynamic and vibrant field that is associated with food safety, food security, and spoilage prevention.[1] The impact of climate change and evolving mycotoxin risks will continue to be important topics in future.[4] Furthermore, the standardization of methods remains a priority, with the ICFM playing a role in updating the ISO horizontal method for enumerating yeasts and molds in food and animal feed. Beyond methodological advances, the ICFM serves as a forum for food mycologists to share and discuss their latest research. The commission also supports regional outreach initiatives, and through these efforts, we aim to promote the global development of food mycology.

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