

OPEN DOORS FELLOWSHIP INTERNATIONAL TRAINING PROGRAM

MODALITY A: APPLICATION TEMPLATE FROM FLEMISH RESEARCH GROUPS.

This modality has been conceived for research institutions in Flanders that are looking for new scientific partners in Africa and are willing to explore new joint research streams with their African counterparts.

The slots open slots offered by the Flemish research laboratories shall be published on the ODFP web page <https://ipbo.vib-ugent.be/en/belgian-research-groups-portal>

Information from the hosting institutions in Flanders

Contact details of a focal point	✉: Sarah.DeSaeger@UGent.be ☎: +32 9 264 81 34
Name of the research or academic institution and acronym	Ghent University (UGent), Belgium.
Name of the research group	Centre of Excellence in Mycotoxicology and Public Health (CEMPH)
Name and position of the focal point supporting the fellow	Esther De Rycke (postdoctoral researcher) Sarah De Saeger (full professor)
Website of institution /research group	https://www.ugent.be/fw/bioanalysis/en/research/cemph

Present the group's research line(s) and activities, including a list of current projects coordinated by the Flemish laboratory

Mycotoxins are secondary metabolites produced by filamentous fungi such as *Aspergillus*, *Penicillium*, *Fusarium*, and *Alternaria* toxigenic species. They contaminate diverse food and feed matrices and can be produced pre- (on field) and post-harvest (harvest, transport, storage, and processing). Despite the efforts and improvements in agricultural production and storage practices, mycotoxin remains a significant threat to the (inter)national economy and global food safety. The situation is expected to worsen due to climate change and global warming. Human exposure to mycotoxins occurs through the consumption of contaminated food such as agricultural crops, cereal-based foods, and animal derived products. The toxicological burden of mycotoxins has been described in literature, and ranges from

gastrointestinal manifestations, weight lost, hepatotoxicity, genotoxicity, estrogenicity to death. The research lines at the CEMPH are organized into the following pillars:

1) Mycotoxin occurrence in food and feed

The most important fungal genera responsible for producing mycotoxins in food and feed commodities include *Aspergillus*, *Fusarium*, *Alternaria* and *Penicillium*. Co-occurrence of mycotoxins produced by a single fungal species is very common, and plants can also metabolize these xenobiotics into modified (masked) mycotoxins. Mycotoxins can be detected by rapid screening tests, such as LFIA, ELISA, dipstick, biosensor and accurately quantified using confirmatory techniques, like LC-MS/MS. **The CEMPH is continuously developing and validating new methods for the detection of multi-mycotoxins in food and feed commodities, with emphasis on LFIA and LC-MS/MS, including optimisation of sample pre-treatment, the synthesis of recognition elements (monoclonal antibodies and molecularly imprinted polymers).**

Launched in January 2024, Prof Sarah De Saeger and Prof Siska Croubels (Ghent University) are coordinating the **Horizon Europe project UP-RISE (EU-AU Partnership for Resilient, Inclusive, and Safe Food Systems for Everyone)**. This project aims to generate groundbreaking insights into mycotoxin contamination and develop solutions to enhance food safety systems in Africa. The consortium brings together 14 international and interdisciplinary partners, including food safety experts, scientists, researchers, agro-economists, biologists, pharmacists, policymakers, regulators, communicators, and mentors. Together, they will work toward strengthening food safety and reducing the prevalence of zoonotic and food-borne diseases. UP-RISE will expand knowledge on mycotoxin contamination within the informal sector, improve predictive tools for contamination, enhance risk assessment frameworks, and create innovative solutions for reducing mycotoxin levels in fermented food value chains.

2) Mycotoxins & human health

This research line focuses on the relation of mycotoxins and human health. As mycotoxins are important toxicological contaminants in the food chain, it is crucial to estimate human exposure to mycotoxins and to assess the impact of these dietary contaminants on public health. In addition to exposure estimation by combining mycotoxin food occurrence data with population data on food consumption, **the direct measurement of mycotoxin biomarkers of exposure in biological fluids** has recently been proposed to perform a more accurate **exposure assessment at individual levels** and **investigate the link with other biological process, dietary pattern, diseases, etc.** For this reason, the CEMPH started several studies whereby a multi-toxin approach was applied to evaluate the exposure in the population on a large-scale (FOD RT 11/02, FOOTBALL and IARC-UGent-IWT-project). Another focus of this research line is to unravel the impact of the occurrence of multiple mycotoxins on human diseases: the CEMPH is participating in the "The Flemish Exposome Project" **FLEXiGUT**, an IBOF-funded project that aims to understand through an holistic exposome approach the role

that the gut microbiome-inflammatory axis plays in chronic diseases. **FLEXiGUT** and the FWO-funded **MYCOGUT** project aim to elucidate the impact of multiple mycotoxin exposure over the life course on the gut microbial composition and the development of chronic low-grade gut inflammation. Moreover, since 2021, the European Research Council (ERC) has funded the **HUMYCO** project: 'Investigating the Human Mycobolome through Uniting Large-scale Epidemiological and Mechanistic Poly-omic Designs'. The **HUMYCO** project is conducting a comprehensive study of the human mycobolome using a large-scale poly-omics approach with a focus on the role of multiple mycotoxin exposure in the aetiology of human carcinomas in the context of both Europe and Africa. Genome-wide mutation spectra associated with exposure to carcinogenic mycotoxins is experimentally determined, as well as extensive biomonitoring. The project will contribute to the identification of cancer risks related to mycotoxin exposure, leading to food-based prevention initiatives.

3) Metabolomics and untargeted analysis

With the rise of the genomic era, it has become clear that fungi have the genetic machinery to produce many more metabolites than are currently known. The CEMPH is using HRMS-technology to enable **comprehensive profiling of fungal metabolomes**. Primary focus is on *Aspergillus flavus*, mainly known for its ability to produce the toxic and carcinogenic aflatoxins. Genome analysis of this fungus identified 55 gene clusters predicted to be capable of producing secondary metabolites. By using a strategy-involving gene targeting and HRMS-based comparative metabolomics, our researchers will unravel yet unknown metabolites produced by this fungi and determine the genes and the pathways involved in their biosynthesis. The CEMPH is also applying HRMS for untargeted analysis to explore the diversity of secondary metabolites produced by other fungi, namely *Fusarium*, *Claviceps* and *Alternaria* Spp.

4) International partners

The CEMPH is actively involved in the association research platform (AOP) 'Mycotoxins and Toxigenic Moulds' (**MYTOX**; www.mytox.be), founded at UGent in 2007 and coordinated by Prof. Dr. De Saeger. MYTOX is a well-structured multidisciplinary research group that strives to solve mycotoxin problems, and is able to provide the most adequate strategies and solutions for different stakeholders. MYTOX is characterized by a high degree of activity and dynamics, and an open-minded research philosophy. The presence of researchers from 5 different faculties, and different disciplines within UGent (i.e. mycology, agriculture, food and nutrition, phytopathology, analysis, sampling, toxicology, exposomics, veterinary sciences, biotechnology and chemistry) leads to a multidisciplinary and targeted approach of mycotoxin-related research questions.

Lastly, **MYTOX-SOUTH®**, established in 2017 and coordinated at the CEMPH, has brought this natural MYTOX collaboration to an international level, to find solutions and strategies to combat the mycotoxin problem worldwide. MYTOX-SOUTH® has been successful implementing strategies and experience from the MYTOX network, extended to a global

context through co-creation. The Open Doors Fellowship perfectly fits the scope of MYTOX-SOUTH®, which is capacity building, networking and bridging gaps between disciplines.

Current projects in the CEMPH:

- UP-RISE - EU-AU Partnership for Resilient, Inclusive and Safe Food Systems for Everyone. 101136649 (Horizon Europe), 01/01/2024-31/12/2027.
- VLAIO IM Spin-off Myco-Tech – A valorized platform for mycotoxin technologies and diagnostics. VALMAS2024000201 (VLAIO), 15/07/2024 – 14/07/2026.
- FLEXiGUT - The Flemish exposome project: towards a comprehensive understanding of the life-course impact of dietary and environmental exposure on chronic low-grade gut. BOFIBO2021001102 (iBOF), 01/01/2021-31/12/2024.
- MYCOGUT - Mycotoxins and gut microbiota, an unresolved interplay towards human chronic low-grade gut inflammation. 12D4423N (FWO), 01/10/2022-30/09/2025.
- HUMYCO - Investigating the Human Mycobolome through Uniting Large-scale Epidemiological and Mechanistic Poly-omic Designs. 41Y07820 (ERC), 01/12/2020-30/11/2025.
- EIRENE-Flanders - Flemish hub of the International Exposome Research Infrastructure EIRENE. 1001923N (FWO), 01/01/2023-31/12/2026.
- Impact of early-life multi-mycotoxin exposure on B cells epigenetic profile and infection by oncogenic viruses: unravelling interaction with immune-regulatory cytokines profiles & co-infections in young children. 3Go85921 (FWO), 01/01/2021-31/12/2024.
- Dietary exposure to multi-mycotoxins as a predisposing factor for oesophageal squamous cell carcinoma in Malawi. BOFDCV2019000901 (BOF), 01/10/2019-30/09/2023.
- FOODSAFETY4EU – Multi-Stakeholder Platform for Food Safety in Europe. 101000613 (EU H2020), 01/01/2021-31/12/2023.
- MYCOVIEW - Early and non-destructive detection of mouldy core disease in apple for prevention of Alternaria mycotoxin accumulation by an innovative machine-learning approach. 1240024N (FWO), 01/10/2023-30/09/2026.
- Efficacy Assessment of Bio-Control Preventive Actions in Maize to Reduce Human Mycotoxin Exposure in Tanzania. 01W01421 (FWO), 01/10/2021-30/09/2026.

- International Thematic Network (ITN) MYTOX SOUTH (B/15182/17, B/15359/50, GMFITN2020000201), Ghent University, 01/01/2017-31/12/2026.

Describe the primary hard and soft skills desirable from the awarded ODFP fellow to deliver the task at hand in the Flemish research group (i.e. *bioinformatics, genetic engineering, chromatography, sequencing, metabolomics, metagenomics*).

The candidate should possess strong wet-lab skills and expertise in LC-MS/MS, including both analysis and data processing.

In terms of soft skills and competencies, the candidate must demonstrate excellent verbal and written communication skills in English, strong interpersonal abilities, and be able to work independently. He/She should also be able to think critically and work effectively within a multidisciplinary and international team.

Indicate the short and long-term outputs that the Flemish research group would like to see arising from this collaboration.

Expected Short-term outputs (1-2 years)	Expected Long-term outputs (after two years)
Within MYTOX-SOUTH®, we are actively expanding our network in the Global South. The fellow and her institute can become a formal MYTOX-SOUTH® partner. We expect to get in touch with new research groups who can join us in our mission to tackle worldwide mycotoxin challenges. Moreover, we will be able to increase human capacity and broaden the already existing skills of the post-doctoral fellow. We expect a contribution to the UP-RISE project and new insights that can be offered by the fellow or his/her institute. Moreover, access to the training modalities foreseen for the fellow is highly valued, and will increase the hard and soft skills of the supervisor. Moreover, we stimulate knowledge transfer from South to South, expecting further	In MYTOX-SOUTH®, we highly value sustainability of our network. We expect that this collaboration will lead to longterm co-creation with the fellow or his/her institute. We have seen already in our network that partners continue to work with us. Therefore, we expect a continuation of our collaboration and expansion of our network with other contacts from the fellow. More specifically, we see 'co-creation' as for instance submitting joint research proposals, thus in collaboration with Ghent University and a sub-Saharan institute. Furthermore, North-South exchange of students (MSc or PhD) and staff should come from this broadened network. Moreover, we can expand our teaching activities in collaboration with the fellow or her institute/partner institute.

dissemination of the acquired knowledge to other students/researchers in the South. We also expect support to increase the external visibility of our research group in sub-Saharan Africa among local stakeholders, including private companies. The fellow could present the obtained results during the program at international conferences or symposia.	
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Summarise (600 - 800 words approx.) the research project(s) to which the ODFP fellow would contribute during the short research stage in Flanders.

The UP-RISE project targets food safety and mycotoxin contamination in five African Union Member states: Benin, Ivory Coast, Kenya, Nigeria, and South Africa. Mycotoxins are particularly hazardous to staple crops like corn, sorghum, and millet, posing serious health risks to humans and animals. Over a two-year period, crop, feed, and milk samples (to investigate carry-over to the animal) will be collected from these countries, with a focus on the detecting aflatoxins, ochratoxins, zearalenone, deoxynivalenol, and fumonisins. The project will employ both rapid screening methods using lateral flow immunoassays (LFIA) and confirmatory techniques such as liquid chromatography-tandem mass spectrometry (LC-MS/MS). The candidate's research objectives within the framework of UP-RISE focus on the development, validation and implementation of standard operating procedures (SOP) for the (rapid) screening, identification and quantification (confirmatory) of multi-mycotoxins in the selected matrices, more specifically: • Multi-mycotoxin analysis using LC-MS/MS on collected crop samples. Staple crops from corn, sorghum, and millet will be collected. While some samples will undergo on-site rapid screening using LFIA, others will be transported to Ghent for confirmatory analysis using LC-MS/MS. This sophisticated technique allows the detection of multiple mycotoxins simultaneously, offering a high degree of sensitivity and accuracy. Therefore, the candidate will be trained on sample-prep, analysis using LC-MS/MS and data processing based on the identification criteria. The candidate will be trained in sample preparation, ensuring efficient extraction and clean-up of mycotoxins from complex crop matrices. The analysis will involve calibration and data processing for identification and quantification.

- **Development and validation of an SOP using LC-MS/MS on cereal-based fermented foods**

Cereal-based fermented foods, which are commonly consumed alongside staple crops in many parts of the world, can be vulnerable to mycotoxin contamination. The fermentation process may alter the chemical structure or concentration of mycotoxins present in the raw material, creating a complex challenge for accurate detection.

To address this, the candidate will develop and optimize a method for LC-MS/MS analysis of cereal-based fermented foods. The method will be applied to samples collected from raw materials, as well as intermediate, both before and after fermentation, and the final product. This process will help to assess how fermentation influences mycotoxin levels and contamination risks.

Validation of this method will include spiking experiments where known concentrations of mycotoxins are added to the fermented food samples to test the method's recovery and sensitivity. Matrix effects will be carefully studied to ensure that the method can reliably detect the mycotoxins. Additionally, inter-laboratory comparisons will be conducted to verify the method's reproducibility and robustness in different settings.

- **Development and validation of an SOP using LFIA on cereal-based fermented foods**

In addition to LC-MS/MS, LFIA provides a more rapid, accessible method for detecting mycotoxins, particularly on-site. The candidate will design a SOP using LFIA in cereal-based fermented food matrices.

The candidate will focus on optimizing the sample pre-treatment by selecting appropriate solvents (and ratio's), and extraction methods to maximize the recovery of mycotoxins from the fermented food. The LFIA will then be validated through a comparative study against LC-MS/MS, evaluating its sensitivity, specificity, and reproducibility. Furthermore, also other parameters like repeatability, cross-reactivity, etc. will be investigated.

Please list any other relevant resources (e.g. articles, videos, project documents and summaries, repositories) related to the targeted projects and the short research stay that would help applicants build up their project proposal for your group.

Information on UP-RISE is available on our website: <https://uprisefoodsafety.org/> UP-RISE is also active on Instagram and Twitter.

Information on MYTOX-SOUTH® is available on our website: www.mytoxsouth.org Moreover, a short video explains the mission of MYTOX-SOUTH®: <https://vimeo.com/375702193>. Mytox-South® activities can be followed on Facebook, Twitter and Instagram.

To complete this application, we need **an official letter from the Principal Investigator of the Flemish receiving group confirming the collaboration with the ODFP**. Please, send the application form and supporting letter as a separate **PDF file**.

Applications must be submitted electronically to IPBO@vib-ugent.be. The application form must be named as follows: "**ODFP_ModalityA_name of short research stay**".