DOCTORAL NETWORK

PhD POSITION N°2

Project title	Influence of pharmaceutical exposure on microbial functions, diversity and antimicrobial resistance development and dissemination in soil
Recruiting institution	University of Thessaly, Greece

BACKGROUND

This doctoral position is 1 of 10 doctoral positions offered within the he HORIZON Marie Sklodowska-Curie Action (MSCA) Doctoral Network Pharm-ERA: "**Improving monitoring and Environmental Risk Assessment of PHARMaceuticals, antimicrobial resistance and pathogens from terrestrial to aquatic environments**".

Global contamination of soil and aquatic ecosystems by pharmaceutical and microbiological pollutants (such as antimicrobial-resistant microorganisms and/or pathogens) raises severe concerns about impacts on ecosystem health and repercussions on humans and animals. Preserving ecosystems from adverse ecotoxicological effects of pharmaceuticals and their transformation products, and limiting the environmental spread of antimicrobial resistance and pathogens is imperative to reach several UN Sustainable Development Goals as well as the European Green Deal, Water Framework Directive and Biodiversity Strategy for 2030. In this context, the main scientific objective of Pharm-ERA is to develop and implement innovative concepts, methods and strategies to improve the monitoring and assessment of the environmental effects and risks of pharmaceuticals, their transformation products, antimicrobial resistances and pathogens from terrestrial to aquatic environments. The ultimate goal is to provide scientific evidence and expertise to contribute to reducing the environmental spread and impact of these chemical and microbiological contaminants and to preserve microbial diversity and functions across the soil-water-sediment continuum.

By joining Pharm-ERA, you will integrate a high-level interdisciplinary and intersectoral research and training network based on 10 doctoral projects covering scientific disciplines including environmental and analytical chemistry, microbial ecology, ecotoxicology, molecular biology (incl. multi-omics approaches) and chemical fate/effect modelling. Pharm-ERA involves 9 Beneficiaries (including 2 non-academics) and 6 Associated Partners (including 5 non-academics), committed to contribute to research, training, dissemination, communication and exploitation of results targeting end-users such as environmental consultancies and agencies.

DESCRIPTION OF THE PhD PROJECT

Veterinary pharmaceuticals enter soil through various routes imposing pollution, toxicity and selection pressure to the soil microbiota. However, the true extent of their impact on the diversity and function of the soil microbiota, which constitute the main contributors to several ecosystemic services, but also the threats for soil food web have not been fully understood.

The project's main aim is to determine the veterinary pharmaceuticals (PhACs) effects on soil microbiota and the associated risk for dispersal of antimicrobial resistance (AMR). This main objective will be achieved through a series of research and technical objectives like:

- O1: define the effects of veterinary PhACs on soil microbial diversity and functions within and across the soil food web;
- O2: explore potential interactive effects of PhACs with other soil-relevant contaminants (e.g pesticides, anthelminthics, plastics etc);
- O3: investigate the role of transformation products on soil microbial toxicity;
- O4: determine PhACs contribution in the dispersal of ARGs in soil ;
- O5: disentangle the role of soil mobilome on ARGs environmental dispersal.

In this frame, selected veterinary pharmaceuticals (antibiotics and anthelminthics) either alone or in combination with other organic pollutants commonly encountered in soil (e.g. pesticides, microplastics) will be at a first stage (Tier I) assayed in single species tests for their toxicity on nitrifiers and arbuscular mycorrhizal fungi - two key functional soil microbial groups with bioindicator value. The outcome of Tier I assays will direct us to soil assays (Tier II and III) were the toxicity of selected (based on Tier I) pharmaceuticals (alone and in combination with other pollutants) will be tested for their effects on the diversity and functioning of the soil microbiota using a range of molecular (q-PCR/RT-q-PCR) and omic tools (amplicon sequencing) combined with the necessary bioinformatic and biostatistics tools. In addition, the dissipation and transformation of pharmaceuticals in soil will be monitored to clarify the level and the duration of the exposure but also to enable potential identification of transformation products (TPs) with toxicity potential. Such TPs, if identified, will be tested for validation of the direct toxicity to the soil microbiota via single species test assays (returning to Tier I).

Finally, the contribution of pharmaceuticals in the development of AMR traits and the role of mobilome and plasmidome in the dissemination of AMR traits will be followed in soil via the use of q-PCR and plasmidome metagenomic analysis while other approaches (e.g. Hi-C metagenomics) will be explored to resolve the mechanism of AMR dispersal. These data will be further utilized for environmental risk assessment of AMR.

PRACTICAL INFORMATION

Recruiting institution	University of Thessaly, Greece
Doctoral school	Department of Biochemistry and Biotechnology, University of Thessaly, Greece
Supervisors	Dr. Dimitrios Karpouzas and Dr. Sotirios Vasileiadis (University of Thessaly, Greece), Dr. Marion Devers (INRAE, Dijon, France)
Non-academic mentor	Dr. Federico Ferrari (Aeiforia s.r.l.), Italy
Main host laboratory	Laboratory of Plant and Environmental Biotechnology University of Thessaly, Greece, Dr. Dimitrios Karpouzas, Dr. Sotirios Vasileiadis to perform toxicity assessments (single species tests, soils assays)
Secondments (1 to 6 hosting months)	1) INRAE, Dijon, France, to get training on MicroResp and high-throughput BIOLOG plates analysis, under the supervision of Dr. Marion Devers 2) AEIFORIA srl, Piacenza, Italy, to get training on high resolution analytical methodologies enabling discovery of the main transformation products of pharmaceuticals in soil, under the supervision of Dr. Federico Ferrari.

RECRUITMENT CRITERIA

General criteria

- MSCA Mobility Rule: researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of the recruiting beneficiary for more than 12 months in the 36 months immediately before their date of recruitment
- All researchers recruited in a DN must be doctoral candidates (i.e. not already in possession of a doctoral degree at the date of the recruitment)
- Scientific excellence to fit the PhD project
- Fluent (oral and written) English skills as the project operates in English language
- Knowledge of the language of the host country may be considered a merit
- Team-mindedness

Criteria specific for PhD2

- Good knowledge in Molecular Biology techniques applied in Soil Microbial Ecology (e.g. soil DNA/RNA extraction, q-PCR, amplicon sequencing)
- Basic knowledge in the use of bioinformatic and statistical tools for microbial ecology
- Basic knowledge of analytical methods (HPLC) for environmental analysis
- Master in Molecular Biology or Microbial Ecology or Environmental Biotechnology

APPLICATION

Documentation to be sent in by the applicants

- Application form completed
- CV + Letter of motivation
- Contact of two reference persons to be contacted by the selection committee (name, relation to the candidate, e-mail address and phone number)
- Complete list of publications and academic works
- Proof of language proficiencies
- Proof of master diploma or 2024 registration to master degree

How to apply?

- Download application form and fill it indicating all the offers you wish to apply for
- Send your application by email to pharm-era@inrae.fr**. The title of your email MUST be : Pharm-ERA PhD x, x, x application** (x, x, x being the number(s) of the PhD position(s) you want to apply for)
- **Be careful to join all documentation required** (see list above)

Deadline for application

April 2024, 14th - 6:00 pm French time

Contact

pharm-era@inrae.fr