Novel Strategies for Understanding and Detecting New Emerging Drugs

Summary

This PhD project focuses on the metabolism, pharmacokinetics, and toxicology of novel and emerging psychoactive substances (NPS), combining in vivo and in vitro models with cutting-edge analytical technologies. In cooperation with Jena University Hospital, Institute for Forensic Medicine, Friedrich Schiller University Jenaand Tallinn University of Technology spin-off venture SafePAS, the project will develop advanced methodologies to detect and understand the biological behavior of new drugs, supporting the creation of fast and accurate field-testing devices for law enforcement and healthcare. The candidate will be part of an interdisciplinary and international team addressing the societal and scientific challenges posed by the rapid emergence of synthetic drugs.

Research field:	Chemistry and biotechnology
Supervisor:	Prof. Dr. Jekaterina Mazina-Šinkar
Availability:	This position is available.
Offered by:	School of Science
	Department of Chemistry and Biotechnology
Application deadline:	Applications are accepted between June 01, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

Description

The research

Illegal drug abuse remains a major global challenge, affecting millions of individuals annually. According to the latest EMCDDA report, an estimated 270 million people used drugs in 2017 (+30% increase compared to 2009), and 56 millions in 2019 (+48% since 1990) have drugs disorder (by IHME).

The UNODC Early Warning Advisory (EWA) continues to register hundreds of NPS annually such as synthetic opioids (e.g., protonitazene, metanzatene), synthetic cathinones (e.g., 4-MMC, 4-MEC, 4-MPD, 4-CEC), novel benzodiazepine analogs (e.g., flualprazolam, clonazolam), and new synthetic cannabinoids (e.g., MDMB-4en-PINACA, 5F-MDMB-PICA), hemp-derived cannabinoids (e.g., HHC, THC-O, THC-O Acetate) and others. The growing use of various NPS, including GHB (gamma-hydroxybutyrate) and ketamine, has raised significant concerns about potential economic, societal, and environmental harms.

Novel psychoactive substances (NPS) and other emerging drugs represent a growing public health and forensic challenge due to their chemical diversity, rapid emergence, and limited toxicological data. The need for fast, precise, and practical detection and evaluation tools is pressing, especially for frontline applications like roadside testing and emergency toxicology.

This PhD project aims to:

- Study the in vivo and in vitro metabolism and pharmacokinetics of emerging drug classes (e.g., synthetic cannabinoids, cathinones, opioids and others).
- Investigate toxicity mechanisms through cell-based assays and experimental models.
- Develop and validate novel analytical methods including miniaturized and portable detection tools for field use.
- Translate scientific findings into applications via collaboration with Jena University Hospital and SafePAS, enhancing the real-world impact of the research.

Key Research Questions

- What are the main metabolic pathways of selected emerging drugs?
- How do metabolic profiles and kinetics affect toxicity and detectability?
- How can novel capillary-based and sensor-integrated analytical systems be optimized for field detection?
- What are the implications for forensic and clinical interpretation, as well as public health response?

Responsibilities and (foreseen) tasks

- Develop and validate experimental models (in vitro, in vivo) for drug metabolism studies.
- Investigate biomatrices treatment, stability, authenticity for emerging drugs investigation.
- Use advanced instrumentation (e.g., LC coupled to mass spectrometry, capillary electrophoresis, and other techniques) for quantification and identification of metabolites.
- Assist in the coordination of joint projects and knowledge exchange with Jena University Hospital and SafePAS.
- Collaborate with engineers and data scientists at SafePAS to integrate findings into portable detection platforms.
- Publish scientific results and contribute to patents, if applicable.
- Present findings at international conferences and stakeholder meetings.

- Contribute to the organization of research and practitioner workshops where project findings are presented.

Applicants should fulfil the following requirements:

- Master's degree in analytical chemistry, toxicology, pharmacology, biochemistry, or a related field.
- Strong interest in interdisciplinary research and real-world applications of forensic science and toxicology.
- Experience in chromatographic or spectrometric techniques (e.g., LC-MS/MS, CE) is highly beneficial.
- Excellent written and spoken English and German.
- Ability to work independently and in collaboration with international teams.
- Open to short-term research stays at partner institutions (e.g., Jena, Estonia).

(The following experience is beneficial:)

- Capillary electrophoresis or electrochromatography.
- Working with biological matrices (e.g., saliva, blood, urine).
- Cell culture and toxicity assays.
- Knowledge of pharmacokinetics, metabolic pathways, or drug–enzyme interactions.
- Software tools for data processing (e.g., MATLAB, Python, R).

<u>The candidate should submit a research plan for the topic, including the overall research and data collection strategy.</u>
We offer:

- A fully funded 4-year PhD position with access to state-of-the-art laboratory infrastructure.
- Supervision by experts in toxicology, analytical chemistry, and device development.
- Participation in a high-impact, cross-sectoral research collaboration with academic and industry partners.
- Opportunities to travel, attend conferences, and join international research stays.
- A chance to contribute to the development of life-saving drug detection tools for law enforcement and healthcare.

About the department

The project will be conducted in cooperation with two universities, Tallinn University of Technology, School Science, Department of Chemistry and Biotechnology, Smart Analytics Research Group and Tallinn University, School of Natural Sciences and Health, supervised by Dr. Jekaterina Mazina-Šinkar (TALTECH) and co-supervised by Dirk K Wissenbach (H index 31, 2700+ citations), Department Toxicology, Jena University Hospital, Institute for Forensic Medicine, Friedrich Schiller University Jena, Jena, Thuringia 00747, Germany.

Jena University Hospital, Institute for Forensic Medicine, l is one of Germany's leading centers for clinical toxicology and pharmacology, with cutting-edge research in drug metabolism and public health.

The internship will be provided by SafePAS OÜ, an Estonian deep-tech company, Tallinn University of Technology spin-off, specializes in the development of portable analytical devices for drug detection (e.g., Drug Hunter analyzer), collaborating with law enforcement agencies and forensic science institutes across Europe.

(Additional information)

For further information, please contact Assistance Prof. Jekaterina Mazina-Šinkar, Smart Analytics Research Group, Department of Chemistry an Biotechnology

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