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INVITATION PUBLIC DEFENSE

Hunting for ticks in Belgium: new insights into symbionts, pathogens and the emergence of Tick-Borne Encephalitis Virus

Camille Philippe

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PROMOTORS

Prof. dr. Bert Devriendt
Faculty of Veterinary Medicine, UGent

Em. prof. dr. Eric Cox
Faculty of Veterinary Medicine, UGent

Dr. Marcella Mori
Sciensano, Belgian Health Institute

Dr. François Dufrasne
Sciensano, Belgian Health Institute

Curriculum Vitae

Camille Antoinette Marie Philippe was born on September 7, 1995, in Sandon, South Africa. She lived there for two years before moving to Fremantle, Australia, where she resided until the age of seven. She then moved to Belgium, where she completed her primary and secondary education. In 2013, she obtained the Certificat d'Enseignement Secondaire Supérieur (CESS) at the Athénée Royal Prince Baudouin in Marchin. She subsequently enrolled at the University of Liège, initially studying medicine. After, she reoriented her studies toward biomedical sciences, enrolling in the Bachelor's program in 2015. Alongside her academic training, she was actively involved in the scouting movement as a scouts chief. After completing her Bachelor's degree in Biomedical Sciences, she pursued a Master's degree at the University of Liège. During the first year of her Master's program, she completed an internship at the FARAH research unit of the Faculty of Veterinary Medicine and presented a poster "L'utilisation du modèle "in vivo" murin et le recours à la cytométrie en flux pour étudier l'influence spécifique des infections virales respiratoires sur l'immunité pulmonaire de type 2". In her second year, she specialized in digestive tract biology and nutrition. Her Master's thesis, was entitled "Monitoring and Characterisation of *Vibrio* spp. Present in Coastal and Recreational Surface Waters in Belgium and Development of a qPCR Method for the Detection of *Vibrio cholerae* in Stool and Water Samples". During the COVID-19 pandemic, she worked at SARS-CoV-2 testing platforms at the CHU de Liège and the Centre Hospitalier Régional Hutois. In 2021, she joined the AIDS Reference Laboratory of the CHU de Liège, where she worked for ten months as a scientist. In 2022, she was enrolled in a four-year joint PhD program between Sciensano, the Belgian Institute for Health, and Ghent University. At Sciensano, she conducted research for two years in the Bacterial Zoonoses unit, of the Veterinary Bacteriology service, followed by two years in the Laboratory of Viral Diseases. At Ghent University, she was affiliated with the Laboratory of Immunology within the Faculty of Veterinary Medicine.

Where?

The defense will take place on 27th April, 2026 at 17.00h

Auditorium D
Faculty of Veterinary Medicine
Ghent University, Campus Merelbeke
Salisburylaan 133, Merelbeke

How to attend?

If you would like to attend, please register before 15th of April by sending an email to camille.philippe@ugent.be

Please indicate whether you would like to participate in the reception following the defence.

Members of the Jury

Prof. dr. Frank Pasmans
Chairman of the Jury
Faculty of Veterinary Medicine, UGent

Dr. Elin Verbrugghe
Faculty of Veterinary Medicine, UGent

Prof. dr. Kris Verheyen
Faculty of Bioscience Engineering, UGent

Prof. dr. Hein Sprong
Rijksinstituut voor Volksgezondheid en Milieu, Bilthoven, Netherlands

Dr. Sara Moutailler
Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail, Maison Alfort, France

Prof. dr. Emmanuel André
Laboratory of Clinical Microbiology, Department of Microbiology, Immunology and Transplantation, Rega Institute, KU Leuven, Belgium

Summary

Ticks are among the most important vectors of zoonotic pathogens in Europe, with Ixodes ricinus acting as the principal vector for a wide range of bacterial, protozoan, and viral agents affecting human and animal health. This PhD thesis aims to improve the understanding of tick-borne pathogen circulation in Belgium by combining citizen science, molecular microorganism screening, and microbiome analyses across ecological contexts. The work is structured around three complementary studies that together explore (i) pathogen prevalence in ticks collected from humans, (ii) the diversity and ecological drivers of the I. ricinus microbiome, and (iii) the emergence of tick-borne encephalitis virus (TBEV) in Belgium.

Citizen science as a tool for tick-borne pathogen surveillance

The first part of this thesis is based on a citizen science approach, enabling the collection of ticks directly removed from humans across Belgium. This strategy provides a way to assess pathogen exposure, complementing traditional field sampling methods that rely on questing ticks. Using ticks collected in 2021 and comparing them to a similar survey conducted in 2017, this study aims to detect pathogen in ticks collected from humans.

Molecular screening revealed that ticks removed from humans carried a diverse range of bacterial pathogens, including Borrelia burgdorferi sensu lato, Rickettsia spp., Anaplasma phagocytophilum, and Babesia spp. Overall pathogen prevalence remained high, confirming that human exposure to infected ticks is frequent in Belgium. Importantly, comparison between the two time points showed changes in pathogen prevalence patterns, suggesting dynamic circulation of tick-borne agents over time. These results highlight the value of repeated citizen science-based surveillance to detect temporal trends and potential emerging risks. Furthermore, this work demonstrates that citizen science is a

powerful, cost-effective tool for the monitoring of tick-borne pathogens while simultaneously increasing public awareness of tick-borne diseases.

Microbiome diversity across ecoregions and its association with pathogens and symbionts

The second part of the thesis focuses on the bacterial microbiome of I. ricinus ticks and investigates how it varies across Belgian ecoregions. Using 16S rRNA gene sequencing, the microbiome composition of ticks was analysed in relation to geographic location and the presence of pathogens and symbionts. Belgium, despite its relatively small size, encompasses distinct ecoregions with differences in climate, land use, and host communities, offering an ideal setting to explore ecological drivers of microbiome variation.

The results revealed that the I. ricinus microbiome is highly diverse but structured, with significant differences in bacterial community composition between ecoregions. Certain bacteria were strongly associated with specific regions, suggesting that environmental factors and local host assemblages influence microbiome assembly. In addition to environmental effects, the presence of pathogens such as Rickettsia spp. was associated with marked shifts in microbiome composition. Ticks positive for this specific pathogen displayed reduced diversity and distinct bacterial profiles compared to non-infected ticks.

These findings support the idea that the tick microbiome is not a passive reflection of the environment but a dynamic system influenced by ecological context and pathogen colonisation. Understanding these interactions is essential, as microbiome composition may affect tick fitness, vector competence, and pathogen transmission. This study provides one of the first detailed characterisations of I. ricinus microbiome variation at a national scale in Belgium.

Emergence of tick-borne encephalitis virus in Belgium

The third part of the thesis addresses the detection of tick-borne encephalitis virus (TBEV) in Belgium, a country historically considered outside the core endemic area for this virus. Through molecular screening of I. ricinus ticks, TBEV RNA was detected for the first time in Belgian ticks in May 2024. Phylogenetic analysis confirmed that the detected virus belonged to the European subtype and was closely related to a strain found in Finland.

This finding has important public health implications, as TBEV can cause severe neurological disease in humans and is often underdiagnosed in regions where it is not considered endemic.

General conclusions and perspectives

Together, the three studies presented in this thesis provide an integrated view of tick-borne pathogen and symbiont circulation in Belgium. By combining citizen science, microorganism detection, microbiome analysis, and TBEV detection, this work demonstrates that Belgium is not only exposed to well-known tick-borne pathogens but also faces the emergence of new risks such as TBEV. The results highlight the importance of continuous surveillance, the consideration of ecological and microbial contexts, and the value of interdisciplinary approaches in understanding and managing tick-borne diseases.

This thesis contributes to improving knowledge of tick-borne microorganisms in Belgium and provides a framework that can be applied to other regions.