

Board of examiners

Dr. Wouter Visser

Centrum voor Gezondheidsbescherming
Rijksinstituut voor Volksgezondheid en Milieu (RIVM)
Bilthoven, Nederland

Prof. dr. Adrian Covaci

Department of Pharmaceutical Sciences
Universiteit Antwerpen, Antwerp, Belgium

Prof. dr. Ann Van Eeckhaut

Department of Pharmaceutical Sciences, Drug Analysis and Drug Information
Faculty of Medicine and Pharmacy, Vrije Universiteit

Prof. dr. Marc Elskens

Department of Analytical, Environmental and Geo-Chemistry
Faculty of Science and Bio-engineering Sciences, Vrije Universiteit Brussel

Prof. dr. Kristien De Paepe, Chair

Department of *In Vitro* Toxicology and Dermato-Cosmetology
Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel

Promoters:

Prof. dr. Tamara Vanhaecke

Department of *In Vitro* Toxicology and Dermato-Cosmetology
Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel

Prof. em. dr. Vera Rogiers

Department of *In Vitro* Toxicology and Dermato-Cosmetology
Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel

Dr. Eric Deconinck

Medicines and Health Products, Chemical and physical health risks
Sciensano, Brussels, Belgium



PhD in Pharmaceutical Sciences
2020-2021

INVITATION to the Public defense of

Sophia BARHDADI

To obtain the academic degree of '**DOCTOR OF PHARMACEUTICAL SCIENCES**'

Chemical and toxicological assessment of e-cigarette liquids

The defense will take place on **Tuesday, 29th September 2020 at 5 p.m.**

and will be organised online via Zoom meeting

accessible through the following link:

https://gf.vub.ac.be/redirects/PhD_defense_Sophia_Barhdadi.php

and in Auditorium Piet Brouwer

Faculty of Medicine and Pharmacy, Laarbeeklaan 103, 1090 Brussel

ADMITTANCE to the auditorium will only be granted upon presentation of the personal invitation from the PhD candidate.

Summary of the dissertation

The popularity of the electronic cigarette (e-cigarette) has increased significantly in the past decade. To assure public health, scientific research about the safety and quality of the e-cigarette is of great importance. The objective of this PhD thesis was therefore to first determine the chemical composition of the liquids used in e-cigarettes (e-liquid) and next to investigate toxicological aspects of flavouring substances present in e-liquid refills. First, a comprehensive literature search was performed to obtain an overview about the chemical composition of the e-liquids and the analytical methods used for their detection. Next, alternative methods were developed for the quantitative determination of nicotine and its related impurities (HPLC-DAD) and for the flavours diacetyl and acetylpropionyl (HS/GC-MS). Also, screening methods were developed for the identification of volatile organic compounds (HS/GC-MS) and the additives taurine (LC-MS/MS) and caffeine (GC-MS). Subsequently, the quality of e-liquids available on the Belgian market was investigated using these developed methods. Also, the risk of inhaling diacetyl present in e-liquids was investigated using an adapted risk assessment methodology for intentional inhalation of substances through the e-cigarette. In the final experimental part of the thesis, we focused on the identification of potential genotoxic flavouring substances in e-liquids through the use of non-animal methodologies. A prioritization strategy combining analytical screening, *in silico* tools and literature data was developed to identify potentially genotoxic e-liquid flavourings. Finally, in order to minimise potential health risks imposed by the use of e-cigarettes, some recommendations are suggested to further amend the current e-cigarette legislation.

Curriculum Vitae

Sophia Barhdadi was born on the 2nd of July 1990 in Borgerhout (Belgium). She attended secondary school direction Latin-Mathematics at Sint-Lievenscollege in Antwerp, Belgium. In 2013, she obtained a Master's degree in pharmaceutical sciences with distinction from the Ghent University (UGhent) which included a 4-month international exchange at Chemiphar laboratories in Kampala, Uganda for the preparation of her Master's thesis. Hereafter, Sophia started the interuniversity advanced Master program in industrial pharmacy and graduated in 2014 with high distinction. To obtain her license for Qualified Person, she finished a 6-month internship between September 2014 and February 2015 in the QC laboratories at Janssen Pharmaceutica (Belgium). Thereafter, she was employed as a QA associate in the laboratories of Pharmaceutical Development and Manufacturing Sciences department of Janssen Pharmaceutica (Belgium). In November 2016, Sophia started her PhD-project about the chemical and toxicological assessment of e-cigarette liquids, which was a collaboration between Sciensano and the department of *In Vitro* Toxicology and Dermato-Cosmetology (IVTD) of the VUB under the joint promotorship of Dr. Eric Deconinck, Prof. Tamara Vanhaecke and Prof. Vera Rogiers. During her project, Sophia also stayed several months at the National Institute for Public Health and the Environment (RIVM) in Bilthoven, the Netherlands to work with smoking machines. Currently, Sophia is working as a scientist at Sciensano and is one of the expert members of the Superior Health Council regarding e-cigarettes.