Introduction

The consumption of dietary supplements and botanicals is not always safe and free of potential health risks. In recent years, cases of contamination with hepatotoxic pyrrolizidine alkaloids, a group of plant secondary metabolites, have raised public health concern. Besides their contamination, the growing use of these products has been accompanied by an increasing number of notifications of adverse reactions related to their adulteration with illicit and undeclared substances, such as pharmaceutical active ingredients or unauthorized plants. The lack of measures to combat these phenomena poses a serious health risk for consumers. Therefore, the collection of reliable and significative data on the occurrence, exposure, and toxicity of both recognized and newly identified contaminants and adulterants is necessary to assess the safety of these product categories. In this context, there is an ever-increasing demand for reliable analytical tools which can detect, identify, and quantify the wide range and variety of toxic and undesirable substances in these products. The presented doctoral thesis is aimed at providing innovative analytical procedures to assess the safety of these product categories and broaden the knowledge about the presence of noncompliant dietary supplements and botanicals on the health market.

In **CHAPTER 1**, the food safety issue of dietary supplements and botanicals regarding their contamination with hepatotoxic pyrrolizidine alkaloids and adulteration with illicit and undeclared substances is addressed from a legislative and scientific perspective.

In **CHAPTER 2**, the development of a sample preparation procedure, based on salting-out assisted liquid-liquid extraction (SALLE), for the fast and cheap extraction and clean-up of pyrrolizidine alkaloids and their N-oxides from different food matrices is discussed.

In **CHAPTER 3**, the design and development of an analytical platform for the detection and identification of pyrrolizidine alkaloids and their N-oxides is discussed; it includes a wide-scope suspect screening method, based on a diagnostic product ion filtering strategy for the characterization of unknown compounds, and a high-throughput target screening method for the detection and identification of 118 target compounds from a mass spectral library.

In **CHAPTER 4** the validation studies of the analytical platform, described in CHAPTER 3, are extended for quantitative purposes and the target screening method is applied to the analysis of a high number of real samples of the studied matrices, regarding the presence of 118 pyrrolizidine alkaloids. The large set of collected data are then discussed from a quali-quantitative point of view to provide an estimate of the contamination issue of the studied food matrices.

In **CHAPTER 5**, the development of a qualitative screening method, based on Surface-enhanced Raman scattering (SERS), for the rapid detection of illicit adulterants and botanical markers of unauthorized plants in dietary supplements using a portable analyzer is discussed.