

1. Abstract

The present habilitation thesis entitled „*Chemical analysis and bioprocessing of some vegetable matrices (lipo- and hydrophilic compounds)*” presents my most relevant academic and scientific achievements starting from the PhD defense in the field of food biotechnology (2008). My research is mainly related to the field of chemistry and biochemistry of lipids and of other biologically active compounds with high antioxidant potential, from unprocessed and bioprocessed vegetable matrices. The competences in biochemistry and analytical chemistry acquired during fellowships were exploited in the development of my research directions.

The structure of this thesis is presented in the following. After a brief introductory chapter, in the second part of the thesis are highlighted the main research directions: (1) Extraction and analysis of lipids from vegetable matrices; (2) Study of biologically active compounds from unprocessed and bioprocessed agro-food residues.

Chapter 2.1. - *Extraction and analysis of lipids from various vegetable matrices* - presents the results of some original studies on the fatty acid composition of the main lipid fractions extracted from: (1) berries of sea buckthorn (*Hippophae rhamnoides* L., subspecies *carpatica*) cultivars; (2) pot marigold (*Calendula officinalis* L.) seed genotypes; (3) multifloral bee-collected pollen from Romanian (Transylvania). In the first case study are presented results on fatty acid composition of the total lipids (oils) and the major lipid fractions (neutral and polar) of the oils extracted from different fruit parts of sea buckthorn (ssp. *carpatica*) cultivated in Romania. No data relating to the fatty acid composition of main lipid fractions from sea buckthorn berries, subspecies *carpatica*, have been previously reported. The aim of the 2nd study on fatty acid composition of lipids in pot marigold (*Calendula officinalis* L.) seed genotypes was to compare the oil content and fatty acid compositions (especially that of calendic acid [18:3 (8t, 10t, 12c) (n-6)]) of total lipids, triacylglycerols, polar lipids and sterol esters in seeds of eleven pot marigold genotypes from six different locations in Europe, grown in the Transylvanian region (Romania). The information obtained is helpful to identify suitable genotypes for use in breeding programs of *Calendula officinalis*. The 3rd study's goal was to provide (in collaboration with colleagues from the Faculty of Animal Science and Biotechnologies, Cluj-N.) useful information for bee pollen consumers as a nutritional supplement, about the lipid classes and

their fatty acid composition, being present in multifloral bee-collected pollen samples. The results have been recently published in a valuable scientific journal (*J. Agric. Food Chem.*).

Chapter 2.2.- *Study of biologically active compounds from unprocessed and bioprocessed agro-food residues*- presents the results of research on my concerns about the composition of agro-food residues and their potential to be used as substrates in fermentation processes (*solid-state fermentation (SSF)*), in order to obtain bioactive compounds with applications in food and/or pharmaceutical industries. *In the first part of this chapter* are presented results on the analysis of lipid compounds (fatty acids and sterols) from the unfermented berry pomaces (wild and cultivated blueberries (*Vaccinium myrtillus*), wild lingonberry (*Vaccinium vitis-idaea*) and raspberry (*Rubus idaeus*) and cultivated black chokeberry (*Aronia melanocarpa*) obtained from fruit processing industry. All these results proved that the non-conventional vegetable oils recovered from analyzed pomaces, with their unique and remarkable biochemical compositions/properties, can be used to prepare functional foods and dietary supplements. *The second part of this chapter (study of biologically active compounds from bioprocessed agro-food wastes)* is based on recently published data in two scientific journals with high impact factor. (*Food Chem.* and *J. Agric. Food Chem.*). There are presented research results on the study of phenolic compounds, antioxidant potential and lipid fractions from: (1) solid–state fermented (by *Aspergillus niger*) berry-wastes (*Sambucus nigra* L. and *Sambucus ebulus* L. berry pomaces) and (2) solid–state fermented (with *A. niger* and *Rhizopus oligosporus*) plum pomaces (from juice industry) and waste from plum brandy production. At the end of this section are also presented data obtained from a research project, on the study of the content of phytosterols and carotenoids from various agro-food residues fermented in solid state system with *A. niger* and *R. oligosporus*. All these studies resulted in a significant increase of bioactive compounds (phenolic compounds, functional lipids and carotenoids) and significant improvement in the antioxidant potential of polyphenol extracts obtained from bioprocessed vegetable matrices. *The research achievements after PhD graduation can be quantified as follows.* I was director of 4 research projects (2 internal grant financed by UASVM Cluj-N. and 2 national research grants), member in 1 international research project and more than 7 national research grants. I published 2 scientific books, 2 teaching books and 1 practical book for students. I am the main author and co-author of 29 papers in ISI journals/ISI proceedings (most of them being awarded by UEFISCDI) (Web of Science: H-index=8, Total number of citations =154), 16 IDB articles and

31 articles/abstracts in journals/book of abstracts of international scientific events; I was invited to review papers for prestigious journals like *Food Chem.*, *Trends Food Sci. Technol.*, *J. of Sep. Sci.*, *Compr. Rev. Food Sci. Food. Saf.*, *J. Food Qual.*, *Chem. Cent. J.*, etc. and I was nominated as reviewer in national competitions for research grants. I received the title of „The *Lecturer* of the year” by UASVM Cluj-N in 2011-2012 and 2012-2013, and „The *Associate profesor* of the year” in 2013-2014 and 2014-2015. I am a member of scientific and industrial organizations, and in the editorial board of a scientific journal.

In the third part of the thesis are presented the strategies for scientific, professional and academic development. The main objective is to increase the scientific quality, international and national visibility of my work. In the future, my research activity will focus on two main directions: (1) Bioprocessing / Bioconversion in SSFsystem; (2) Extraction, characterization and testing of biologically active hydro- and lipophilic compounds. The proposed activities in the future aim to correlate the research and educational activities.