

HABILITATION THESIS

ABSTRACT

BIOCONVERSION PROCESSES AND PROBIOTIC IMMOBILIZATION WITH IMPACTON BIOECONOMY AND NUTRITION

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The present habilitation thesis presents my professional achievements with respect to research activities developed after PhD graduation (September 2010) in the field of food biotechnology. The selected activity is considered to be relevant in the terms of originality and importance, in order to anticipate an independent development of the future research and academic career.

The habilitation thesis entitled "*Bioconversion processes and immobilization of probiotic bacteria with impact on bioeconomy and nutrition*" presents the most relevant scientific achievements, describing the significant results sustained by the publication of 21 ISI papers and 5 patents applications.

The scientific activity on food biotechnology, has been focused on specific topics as: bioconversion issues (production of bioactive compounds from food and industrial wastes) and nutrition immobilization of probiotic bacteria and edible films).

After a brief introductory chapter (A), section B (scientific achievements) shows the main addressed topics described in the current thesis; namely: (1) *Microbial bioconversion for bioactive compounds production*; (2) *Microencapsulation of probiotic bacteria: technology, assessment, applications*; (3) *Antimicrobial edible films*.

Chapter (2.1)- *Microbial bioconversion for bioactive compounds production*- shows original studies based on the potential of wastes (crude glycerol, dandelion extract, lucerne green juice, berry pomace) to act as substrates in fermentation processes, in order to obtain bioactive compounds with applications in food industry. The first study, presented in this chapter shows the potential of crude glycerol to be used as carbon source in pelletized fungal fermentation for L-lactic acid production. This work introduced sustainable opportunities for L (+)-lactic acid production via *R. oryzae* NRRL 395 fermentation on biodiesel crude glycerol media. The results

showed good fungal growth on crude glycerol with lucerne green juice supplementation. In the second study is presented the FTIR characterization of lactic acid fermentation in media supplemented with natural prebiotics. These preliminary results offer interesting information and FTIR spectral indications for lactic fermentation of plant substrates. Developing specific biomarkers by FTIR spectroscopy could be very important for future investigations of *L. casei*-mediated fermentation.

Chapter (2.2)- *Microencapsulation of probiotic bacteria, technology, assessment, applications*, shows studies developed on probiotic bacteria immobilization in different matrices; survivability of probiotic bacteria during exposure to simulated gastrointestinal juice; viability of probiotic bacteria during different storage conditions and food applications including microencapsulated probiotic bacteria. The active delivery of probiotic cells in microencapsulated form has received reasonable attention during the last years, since it can reduce losses of sensitive bacteria induced by detrimental external factors during storage and digestion and due to their potential use in the prevention of gastrointestinal diseases and use in the formulation of new products. In this chapter are presented results obtained in the co-encapsulation system of probiotic bacteria with natural extracts.

The growing interest in natural antimicrobials led to the assessment antimicrobial potential of different natural extracts. Applications of antimicrobial films to fruits, vegetables and meat products have received increasing interest because films can serve as carriers for various natural antimicrobials that can maintain fresh quality, extend product shelf life and reduce the risk of pathogen growth. Chapter 2.3- *Antimicrobial edible films*- shows results of antimicrobial activity of different natural extracts (minimum inhibitory concentration, minimum bactericidal concentration) on Gram + and Gram- strains. Moreover, in this chapter are showed the antimicrobial activity results of different edible films on food products.

The research achievements after PhD graduation can be quantified as follows: 2 book chapters in *Encyclopedia of Biomedical Polymers and Polymer Biomaterials* Taylor & Francis: New York; 2 scientific books, 1 teaching book, 2 practicles. I am the main author and co-author of 19 papers in ISI journals and 16 BDI articles. 16 papers were awarded by UEFISCDI. The conducted research resulted in 5 applications for patents and 7 research projects.

The value of this patents is certified by international awarded recognition (2 medals and 3 awards). Moreover, my international visibility and prestige brought me in the year of 2014 "Danubius Young Scientist Award" in Vienna. In 2014, I was nominated in the *Top 100 "oameni*

care mișcă țara în direcția bună "by Foreign Policy Romania -for research and innovations activities. In June 2015, I was awarded with Excellence Diploma within the national competition „Young Researches in Science and Engineering”. Also, this year I was selected as one of 30 others semifinalists in the European competition „*European Social Innovation*” from 1408 applications across Europe. I received in the frame of *Aspen Leadership Awards* the *Innovation and Technology Award*. I received the title of „Teaching assistant of the year” by USAMV several years in a row (2011-2012, 2012-2013, 2013-2014). I am a member of scientific and industrial organizations, membership in two journal editorial boards and reviewer for more than 20 journals. Also, I am a member of scientific advisory group in the frame of FP7 project: Grail.

The third part of the thesis presents the development plans of my scientific, professional and academic plans. The first objective is to increase the scientific quality, international and national visibility of my work. My future research will be focused on two main directions: (1) bioconversion of waste into valuable organic chemicals and (2) food bioprocesses. Significant opportunities to obtain new valuable results are identified by enlarging the research team, which will involve future Master and PhD students, and by accessing of national/international funds for supporting and promoting research.

My academic activity will be focused on the correlation between research and education, promotion of innovation in applied research and educational methodologies, collaboration with industry, and on the student needs and expectations.