Universitatea „Alexandru Ioan Cuza” din Iaşi

REZUMAT TEZĂ DE ABILITARE (EN)

Conferenţiar universitar dr. OPRICĂ Lăcrămioara Anca

2023

HABILITATION THESIS ABSTRACT

Evaluation of the biochemical response to plant and fungal species under abiotic stress conditions. Possible implications in biotechnology

Associate professor dr. OPRICĂ Lăcrămioara Anca

2023

In the habilitation thesis entitled “Evaluation of the biochemical response to plant and fungal species under abiotic stress conditions. Possible implications in biotechnology ” are summarized the most important scientific results obtained in teaching and research activities undertaken after the doctoral thesis (April, 2005), at the Faculty of Biology, Alexandru Ioan Cuza University of Iasi. These multidisciplinary researches were approached/carried out together with colleagues from the faculty where I work professionally, but also with collaborators from other university centers in the country/abroad, however in this thesis most of my own contributions will be presented.

The thesis is structured as follows: Section A details the main "Professional, scientific and academic achievements" developed by the candidate, presenting the representative scientific results (books, book chapters, directions of interest/research); Section B presents the "Plan for the evolution and development of the professional, scientific and academic career" the proposed objectives and the directions of future research. The habilitation thesis ends with a bibliography, which includes the references that support the research.

The first part of the habilitation thesis reveals the main professional, scientific and academic achievements obtained after doctoral graduation, being structured as follows: in the AI section are briefly presented books and book chapters published by publishing houses in the country and abroad, and in the AII section are selected the most representative own contributions in the multidisciplinary scientific activity that reflect, moreover, the research directions approached. Thus, in this last subchapter are presented the studies performed and oriented the three research directions that aimed at: (1) the biochemical response of plants (glycophytes and halophytes) to saline stress, (2) the uses of cellulosic fungi in biotechnology and (3) variation of the antioxidant content of Romanian fruits.

Starting from the premise that human nutrition is one of the fundamental supports of its construction, the essential element of life, I have in the book *Food Biochemistry* (single author) some aspects of chemical composition of the food, some chemical and biochemical processes that may occur during food processing, storage and handling. Thus, in the first part of the book have been presented the generalities of the main biomolecules of food interest (proteins, carbohydrates, lipids, water, mineral salts, vitamins), as well as their implications in the food industry. Knowing that the health and balance of each individual is directly correlated with food, in the second part of the book I described, after comprehensive

documentation, the main food groups (milk, meat, eggs, cereals, fruits, vegetables, legumes, alcoholic beverages), emphasizing their role in human nutrition.

The deepening of the documentation regarding the active compounds in plants, more precisely of the secondary metabolites, led to the writing of the book *Secondary metabolites in plants. Origin, structure, functions* (single author). The book is an updated interdisciplinary study in which we presented researches (supported by a relevant literature) on the most representative secondary metabolites of plants, their role as signalling molecules, intercellular communication molecules with plants, microorganisms, insects and other organisms involved in the ecology of plant micro- and macrosystems. More precisely, the book set out, in addition to the various generalities on organic compounds in plant organisms, the particularities of the main classes of the secondary metabolites (phenolic compounds, glycosides, terpenes, alkaloids, essential oils, resins and balms), with reference to the classification, chemical structure biosynthesis, physiological functions and practical uses of these true "secrets" possessed by most plant species, mentioning the many representatives that influence the human health.

A first direction of the research developed in subchapter **AII.1.** belong to the current context of soil salinization, a serious and widespread phenomenon in different bioclimatic areas of the world. Thus, due to the increased interest in this important global problem, that negatively affects crop productivity the studies on biochemical changes of plants (glycophytes and halophytes) to saline stress were approached. Given the above-mentioned, ecophysiological and biochemical studies have been performed regarding the salinity effect on medicinal plants (*Ocimum basilicum, Calendula officinalis, Trigonella foenum-graecum*) and cultivated plants (*Glycine max, Brassica napus, Petroselinum crispum, Hordeum vulgare*), as well as some ways to ameliorate/remove the harmful effects of this type of stress. On this subject, some strategies have been developed to reduce the negative effects of salinity in order to produce salinity tolerant genotypes, such as: application of proton fascicles treatment, use of plant growth-promoting rhizobacteria (PGPR), administration of selenium nanoparticles. Last but not least, in this subchapter were included biochemical studies performed on halophytes harvested in different growth stages (vegetative, flowering and fruiting phases) in native areas (Ilena Valley reservation, different locations in Dobrogea - Sulina, Histria).

The second direction of interest developed in the research activity developed in subchapter **AII.2.** is focused on the possible uses of cellulosic fungi in biotechnology. In the context of the intense production of plastics and the desire to safely remove of them, the focus

was on obtaining biodegradable plastics. The plastics made from biodegradable polymers are environmentally friendly and polylactic acids can replace synthetic polymers. In this regard, the role of fungi (*Chaetomium globosum* and *Phanerochaete chrysosporium*) in the biodegradation of polylactic polymers (PLA) was evaluated by identifying of some oxidative stress markers such as antioxidant enzymes activity or malondialdehyde content, one of the byproducts of lipid peroxidation. Chitosan-enriched lactic polymers and rosemary bioactive compounds exposed to different treatments (nitrogen plasma activation, gamma irradiation with 10 kGy, 20 kGy and 30 kGy and coated with chitosan) were tested. In addition to the biochemical determinations, performed on the fungal species, a series of modifications of the physico-chemical properties of the polymers were investigated, before and after incubation with the fungal cultures.

Silver nanoparticles are released into the environment following various uses (technical or biomedical) and studies on silver nanotoxicity have been widely developed. In this sense, the response of *P. chrysosporium* species to the action of different concentrations of silver nanoparticles (investigated by SEM, TEM and EDX assays), quantified by biochemical parameters, was analyzed.

It is known that microorganisms can affect the textiles and by degrading or damaging. In this sense, the role of fungi (*Trichoderma viride* and *P. chrysosporium*) was for testing textiles that had previously been treated with a mixture of glycidyl acids and esters (glycidyl palmitate and glycidyl laurate) with possible antifungal effect. In this sense, we determined the role of the fungi (*Trichoderma viride* and *P. chrysosporium*) for testing textiles previously treated with a mixture of glycidyl acids and esters (glycidyl palmitate and glycidyl laurate) in order to identify a possible antifungal effect. Thus, SEM analyzes and FTIR spectra were performed indicating different degrees of deterioration on the investigated textile materials.

A third field of interest, approached in scientific research and developed in subchapter **AII.3**., has as main concern the variation of the antioxidant content of Romanian fruits. Starting from the benefits of fruit consumption associated with the prevention and reduction of the diseases risk, the research has been focused on determination of the secondary metabolites with antioxidant activity (total polyphenols, flavonoids, anthocyanins). In addition to the cultivated Romanian fruits (apples, cherries, grapes) from certified orchards, some fruits collected from spontaneous flora (*Empetrum nigrum* and *Rosa canina*) were also investigated. Knowing that the distribution of secondary metabolites is different and unequal in the fruit components (seed, skin and pulp) we performed their analysis on different grape varieties (Cotnari, Fetească and Tămâioasă). Possible use in the food and pharmaceutical

industry or due to the high antioxidant content of grapes, led to the investigation of the effect of the thermal drying method (oven drying) and the non-thermal drying method (lyophilization) on the antioxidant content (flavonoids and total polyphenols) for two varieties of red grapes (Cabernet Sauvignon and Merlot), more precisely on the different components (seeds, skin and pulp). On the other hand, it is well known that apples are an accessible source of polyphenols and their consumption is associated with beneficial effects on health, the reason why the content of secondary metabolites of the tested varieties was studied comparatively: Starkrimson, Idared, Golden Delicious, Jonathan, Mutsu, Prima and Wagner. For biochemical analyzes, cherry varieties with different ripening times were also selected, as follows: varieties with early (Cătălina, Rivan and Scorospelka) or medium ripening time (Van, Bucium and Ștefan), as well as varieties with late ripening time (Galata, Hedelfingen and Marina). Regarding the genotypes of rosehips (*Rosa pendulina, R. tomentosa, R. canina, R. rubiginosa, R. corymbifera* and *R. nitidula*) investigated they were collected from the spontaneous flora from different altitudes analyzing how a certain variety/genotype influences the content in antioxidants (anthocyanins, total polyphenols, flavonoids, vitamin C).

The second part of the habilitation thesis refers to the future directions of professional, scientific and academic career development. The elements of continuity and novelty that will be reflected in the evolution of one's professional career are briefly presented.

I started my teaching career in 2004 – as an assistant, at the Faculty of Biology at ”Alexandru Ioan Cuza” University of Iaşi, after previously working for 10 years as a scientific researcher in the Laboratory of Microbiology, Institute of Biological Research Iasi. In 2007, I was promoted, through a competition, to the position of Lecturer, and from 2020, also through a competition, I was promoted to the position of Associate Professor, a teaching degree that I still have. As a Lecturer and then as Associate Professor, I was titular at many disciplines, including: Food Biochemistry (Master in Microbial and Cellular Biotechnology); Biochemistry of microorganisms metabolites (Master in Microbial and Cellular Biotechnology); Secondary metabolites (Bachelor of Biochemistry); Principles of chronobiology (Master of Developmental Biology); General Biochemistry (Bachelor of Biology); Biochemistry (Medical Physics / Biophysics License); Metabolic transformations in agri-food raw materials (Master Bioprocesses in agri-food).

The research results were concretized and finalized in the form of scientific articles published in ISI-quoted/indexed journals (41 papers) or in international databases (BDI) (over 87) as well as articles *in extenso* in conference volumes (48). The results that formed the basis of the elaboration of this habilitation thesis were published in ISI Thomson-Reuters (in the

period 2006-2020) in fields such as: Biology, Plant Science, Polymer-Science, Chemistry, Multidisciplinary, Plant Science, Biochemistry & Molecular Biology, Pharmacology & Pharmacy, Biotechnology & Applied Microbiology, Public Health & Environment etc.

Convinced that national and international visibility is closely correlated with the value of scientific research, primarily quantified by publications in ISI-rated journals, supported and motivated by research projects, I was interested for obtaining projects funded by national and international competitions. As a result, starting with 2006 (after obtaining of the doctoral title in the Biology), I was included, as a specialist, in the research team of numerous scientific projects (19 projects, of which 8 international-bilateral) and, subsequently, I have coordinated projects as director (10 scientific research projects, one of which as Partner Manager from the "Alexandru Ioan Cuza" University of Iaşi).