

**"VICTOR BABEȘ" UNIVERSITY OF
MEDICINE AND PHARMACY TIMIȘOARA
DOCTORAL SCHOOL
PHARMACY DOMAIN**



**A ROBUST SYNERGY OF MULTIDISCIPLINARY
RESEARCH STUDIES:**

**investigations through instrumental, physico-chemical and imaging
analytical techniques of organic, inorganic and hybrid chemical
compounds with pharmaceutical and biomedical applications**

ABSTRACT

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The habilitation thesis, entitled "A ROBUST SYNERGY BETWEEN MULTIDISCIPLINARY RESEARCH STUDIES: investigations through instrumental analytical, physico-chemical and imaging techniques of some organic, inorganic and hybrid chemical compounds with pharmaceutical and biomedical applications", presents the academic course that I have followed from 2012, after the defense of the Doctoral Thesis - "Physico-chemical study of some biomimetic and bioactive materials".

The habilitation thesis is structured in the form of 4 chapters that include information related to university, professional and research activity, as follows: chapter 1 – scientific achievements, chapter 2 – academic achievements, chapter 3 – professional activity, and respectively chapter 4 – academic and scientific perspectives.

Chapter 1, in which the scientific achievements are presented, begins with a brief presentation of the scientific results obtained in the framework of the research studies carried out for the elaboration of the Doctoral Thesis "Physico-chemical study of some biomimetic and bioactive materials", which was publicly defended in 2012, awarded „Magna Cum Laude”.

After reviewing the research studies carried out, the results obtained, as well as the conclusions drawn up within the Doctoral Thesis, the chapter continues with the detailing of the research studies that were carried out after obtaining the doctorate. They have been divided into 3 sub-chapters, each of which has an identical structure, which includes: the introduction, specific published works and personal scientific contributions.

In the first subchapter, the evaluation of the thermal stability, the compatibility in binary mixtures with excipients and the kinetic behavior of some pharmaceutical active molecules (among them, entacapone, mycophenolate mofetil, memantine, adamantan-2-one, as well as bisphosphonates of different generations) is described. Possible interactions were investigated by infrared spectroscopy (FTIR), thermogravimetry (TG), differential thermogravimetry (DTG) and differential thermal analysis (DTA/HF) studies. These analyzes can be performed individually for the active pharmaceutical agent and the excipients, but for the conclusion to be drawn from the study, the same experiments were performed on the binary mixtures (1:1, w/w) of the active pharmaceutical compound with the excipients used for the compatibility study. Moreover, by means of the kinetic analysis a quantitative description of the thermal behavior is possible, this being a first and necessary step in the prediction of the lifetime of an active pharmaceutical compound. The kinetic analysis methods applied in the studies are: Friedman isoconversion (FR), Flynn–Wall–Ozawa (FWO), Kissinger–Akahira–Sunose (KAS), respectively Li–Tang (LT) methods, as well as the nonparametric modified NPK method.

In the second sub-chapter, the characterization of the physico-chemical behavior of some polyurethane and polyester type polymers is described, as well as the synthesis and characterization of the physico-chemical behavior of an organic/inorganic hybrid composite material with bioactive potential. For the investigation and physico-chemical characterization of the studied polymers, elemental analysis studies, FTIR spectroscopy (using U-ATR, respectively EGA techniques) and TG/DTG/DTA in air, respectively in nitrogen, were carried out. For the kinetic study, the kinetic analysis methods presented above were implemented.

In the last subchapter of this section, the impact of the degree of tissue bioaccumulation of some heavy metals is analyzed through the lens of a more complex study. These research studies in the field of impact analysis of the degree of tissue bioaccumulation of some heavy metals followed a new direction compared to the others, and this fact is due to winning an individual research project for obtaining a postdoctoral scholarship. Personal scientific contributions were the determination of heavy metal content (Fe, Zn, Cd, Cu and Pb) by microwave-generated plasma-coupled atomic emission spectroscopy (MP-AES).

Chapter 2 is dedicated to the presentation of the academic activity that I carried out in parallel with that of scientific research and which has the role of completing the academic course taken after obtaining the doctorate.

With the completion of my doctoral studies, on the one hand, I continued my course in the field of thermal analysis applied mainly to active pharmaceutical compounds, but I also diversified my field of interest by participating in the post-doctoral studies program "Doctoral and post-doctoral programs doctoral degrees of excellence for the training of highly qualified human resources for research in the fields of Life, Environment and Earth Sciences", ID: POSDRU/159/1.5/S/133391. This project was carried out for a total period of 16 months, and for a period of 3 months (February - April 2015) I carried out research studies, within the project, at the University of Debrecen (Hungary), within the Faculty of Science and Technology, Department of Applied Chemistry.

The academic activity first of all assumed the completion of all the stages corresponding to the didactic degrees, being, in turn, assistant professor from 2012, head of works from 2016, and in February 2023 I obtained, also through a competition, the position of university lecturer in the Department of Pharmaceutical Sciences of the Faculty of Pharmacy of the Western University "Vasile Goldiș" in Arad. Throughout this period, I was a holder of the discipline of Organic Chemistry, but my personal teaching portfolio also includes other subjects such as: General Chemistry, General and Food Chemistry and Biochemistry, respectively.

The academic activity was complemented by the dissemination of scientific results obtained from research studies carried out together with different inter- and multidisciplinary teams: 27 ISI scientific articles published since 2013, accumulating a number of more than 350 citations according to WoS resulting a H-index of 11, respectively the participation with more than 50 papers presented as oral or poster presentations at numerous international and national conferences, congresses and symposia. Special attention was also paid to book publishing, being the author or co-author of 10 titles published with ISBN, at CNCSIS-recognized publishing houses.

Since 2017 I participated as a reviewer for a number of 8 scientific articles submitted for publication to the Journal of Thermal Analysis and Calorimetry, which publishes high-quality papers covering all aspects of thermal analysis, calorimetry, thermodynamics, heat and energy.

Since the first year of the educational activity carried out within the Western University "Vasile Goldiș" in Arad, an active personal involvement in academic life was realized by participating in the organization of scientific events of the Faculty of Pharmacy, but also as a member of the commissions for the elaboration of the subjects of admission, respectively in study completion committees, and since 2023 I was elected a member of the Council of the Faculty of Pharmacy.

Chapter 3 is a more diversified one, at least in terms of content because personal development is a robust process that is able to leave a significant mark on the way of self-perception, but also on the perception of the social and professional environment. Direct and constant involvement in activities that can develop skills, competences, knowledge, but above all confidence in one's own strength always leads to awareness of one's own potential, which once unleashed can lead to the achievement of any proposed objectives. Investing in personal and professional development has always been a priority, so I attended a series of accredited courses and workshops, which resulted in a series of additional qualifications and certifications.

In addition, this chapter also described the activity that was carried out in the field of non-formal education, facilitated through non-governmental organizations. Through these organizations, it was possible to carry out educational projects for youth in several fields, but the main pillars are the promotion of a healthy lifestyle, respectively the promotion of education in the STEM field. In other words, the development, in parallel with the university career, of some non-formal education projects in fields close to the university was carried out - the promotion of a healthy lifestyle being correlated with the specialization of Nutrition and Dietetics in which I teach, respectively the promotion of

STEM education being close to the Pharmacy specialization, where I also support the Organic Chemistry course. In practice, a rapprochement was achieved between university and pre-university environments, respectively between formal and non-formal education, an experience that helped me enormously in developing a program for non-formal education.

The last of the chapters, chapter 4, includes scientific, academic and professional perspectives, well outlined for the short and medium term, but also some for the long term that are related to the vision for the development of non-formal education programs to increase the degree of scientific literacy of young people who want to study in the biomedical field.

From a scientific perspective, it is proposed to achieve a synergistic combination of the fields studied so far to support the improvement of scientific research capacities in an interdisciplinary and multicultural academic environment in the field of synthesis of bioactive hybrid organic/inorganic injectable composite materials used in bone regeneration.

From an academic perspective, in the short term the objective of obtaining the teaching degree of Full Professor is envisioned, and in the medium and long term, from the perspective of university management, I consider that I already have the appropriate academic, managerial and entrepreneurial experience to occupy various administrative positions in within the Faculty of Pharmacy, respectively of the Western University "Vasile Goldiș" in Arad, depending on the opportunities that will be available in the future.

From a professional perspective, I am determined to build and then implement the management strategy for the development of the program for non-formal education STEM s.y.S.T.E.M.s., a concept that was launched as a pilot program on 08.02.2024, with the University of Vest "Vasile Goldiș" from Arad and the Arad County School Inspectorate, and the promoter is the organization I currently chair, the Activ pentru Comunitate Association.

As a conclusion that probably comes to close a symbolic circle that had its starting point within the title of the Master's Thesis, I am confident in my own ability to achieve in the future at least as robust a synergy in terms of the development of research perspectives scientific corroborated with academic, didactic and professional ones. The development of the scientific research strategies presented in the thesis, already implemented and experienced, but also the expansion of collaborations with other research teams with additional skills, which complement their own studies, are the premises that will facilitate the achievement of more competitive results at the international level. Also, the development of the program for non-formal STEM education s.y.S.T.E.M.s. both at the local level and through future international collaborations initiated through the ERASMUS+ teaching mobilities, will result in the creation of new dialogue partnerships and cooperation networks both in the area of formal and non-formal university education.