


INTERVIEW



Professor José Luis Capelo Martinez, a researcher who believes that science and technology have a direct and tangible impact on human well-being kindly granted BrJAC an interview

J. L. Capelo Martinez, PhD,  gets his bachelor's degree in chemistry by the University of Santiago de Compostela (Spain), his doctorate in Analytical Chemistry by University of Vigo, UVIGO (Spain, award to the best doctoral thesis 2002) and his Post-Doc from the Instituto Superior Técnico de Lisboa (Portugal). His academic career comprises assistant to staff and lecturer at the UVIGO; research fellow at the Chemistry Department of the New University of Lisbon, CD-FCT-UNL, research fellow at the CDUVIGO, and assistant professor at the CD-FCT- UNL. Currently he is Associate Professor at the CD-FCT-UNL. Dr. Capelo is co-head of the bioscopegroup (www.bioscopegroup.org) and his CV comprises (up to October 2023): 290 manuscripts; 250 congress communications (orals and posters); 23 projects; 2 Patents, 1 license agreement and 3 books (1 authored and 2 edited). He has chaired 65 international conferences and is presently involved in the direction of 7. He was a member of the advisory board of Talanta from 2006 to 2014 and is Editor in Chief of the on-line Journal JIOMICS (www.JIOMICS.com) since its creation in 2011. He is presently mentoring or co-mentoring a total of 3 doctoral theses, and he has mentored 3 post-doctoral grants, 17 doctoral grants, 9 masters and 8 final projects. His current research interest is devoted to developing new methodological approaches in personalised medicine using new proteomics approaches and unravelling bacterial resistance to antibiotics. He is a Fellow Member of the Royal Society of Chemistry, member of the American Chemical Society and member of the Portuguese Society of Chemistry. H index 45 (Scopus Scholar). 8300 Citations.

His skills include sampling and sample treatment for trace metals; metal speciation, proteomics, biomarker discovery; food chemistry; and development and validation of analytical procedures. Analytical techniques: HPLC-ICP-MS, ET-AAS, F-AAS, CVAAS, HG- AAS, HG-AFS, MALDI-TOF-MS/MS, RP-HPLC-ESI-IT-MS/MS. Teaching (theory and laboratory) in Analytical Biochemistry, Proteomics, and related disciplines.

Awards: Best 2002 Doctoral Thesis in Chemistry. University of Vigo. Spain. Rainbow Prize 2017.

BrJAC: How was your childhood?

Dr. Martinez: My childhood was marked by a challenging situation within my family. It was a period of turmoil and uncertainty, where I often grappled with complex emotions and circumstances beyond my control. Family issues cast a long shadow over those formative years, making it a time of profound introspection and self-discovery.

Amidst the chaos and adversity, I found solace and refuge in the realms of science and culture. These two pillars became my sanctuary, offering respite from the tumultuous environment surrounding me.

Cite: Professor José Luis Capelo Martinez, a researcher who believes that science and technology have a direct and tangible impact on human well-being kindly granted BrJAC an interview. *Braz. J. Anal. Chem.* 2024, 11 (43), pp 3-10. <http://dx.doi.org/10.30744/brjac.2179-3425.interview.jlcmartinez>

I discovered that delving into the world of knowledge provided a sense of purpose and direction, allowing me to channel my energies into something constructive and meaningful.

With its unending mysteries and the pursuit of understanding the natural world, science became a source of fascination and wonder. It provided me with a sense of order and logic, offering explanations for the phenomena I encountered in everyday life. Through books, experiments, and exploration, I embarked on a journey of intellectual curiosity that would shape my future aspirations.

“...culture offered me a window into diverse perspectives and experiences beyond my own. Literature, art, music, and history provided an escape into different worlds and eras, allowing me to broaden my horizons and cultivate empathy...”

On the other hand, culture offered me a window into diverse perspectives and experiences beyond my own. Literature, art, music, and history provided an escape into different worlds and eras, allowing me to broaden my horizons and cultivate empathy. Engaging with cultural expressions became a way to connect with humanity's collective wisdom and creativity.

While the family issues I faced during my childhood were undeniably challenging, they inadvertently propelled me toward the pursuit of knowledge and self-improvement. I learned that adversity can be a catalyst for growth and resilience, and it

was during those difficult times, that I forged a deep-seated commitment to science and culture as vehicles for personal transformation.

In retrospect, my childhood struggles taught me that even in the darkest moments, there is always a beacon of light to be found in pursuing knowledge and appreciating human creativity. These experiences have shaped my character and fueled my passion for lifelong learning and a profound respect for the transformative power of science and culture.

BrJAC: What early influences encouraged you to study chemistry? Did you have any influencers, such as a teacher?

Dr. Martinez: I consider myself incredibly fortunate to have experienced a formative period in my life that was enriched by the guidance of a truly remarkable individual – a woman whose passion for science was both contagious and inspiring. From the ages of 15 to 18, during three consecutive years that were instrumental in shaping my academic journey, she imparted to me the wonders of physics and chemistry. This remarkable educator, her name was Cármen, driven by an unwavering dedication to her craft, ignited in me a deep curiosity and fascination for the world of science. Her teaching transcended the boundaries of textbooks and classroom walls; it was an immersive experience that brought abstract scientific concepts to life. With her guidance, I ventured into the realms of physics and chemistry, unraveling the mysteries of the universe at a level that I had never before imagined.

But the influence of great teachers extended beyond this singular mentor. I was fortunate to be part of an academic environment that boasted an excellent cohort of educators, all contributing to nurturing young minds. My educational journey unfolded at the best public institute in my hometown of Vigo (Santa Irene), where knowledge was valued and intellectual growth was nurtured.

Reflecting upon those transformative years, I have realised that my secondary school education was perhaps the most influential and pivotal phase of my life. It was a period when the seeds of curiosity were sown, my passion for science was ignited, and the foundations of lifelong learning were firmly laid.

Education at the secondary school level carries the potential to shape the course of one's life profoundly. During these critical years, we are not only introduced to the subject matter but also to the ways of thinking, problem-solving, and questioning that will accompany us throughout our academic and personal journeys. The teachers who guide us during this time play an important role in nurturing our intellect, curiosity, and ambition.

Looking back, I am deeply grateful for the incredible educators who crossed my path, their dedication, and their unwavering belief in the potential of their students. Their influence, combined with my passion for science and the nurturing environment of my school, propelled me in the right direction and set me on a path of intellectual discovery and growth.

As I continue my academic and professional journey, I carry with me the profound impact of those years and the invaluable lessons learned from exceptional educators. It is a testament to the enduring power of education, mentorship, and the pivotal role that teachers can play in shaping the future of their students.

BrJAC: How was the beginning of your career in chemistry?

Dr. Martinez: The beginning of my career in the field of chemistry was marked by two remarkable mentors who left an indelible mark on my academic journey – Professor Carlos Bendicho, my doctoral mentor, and Professor Ana Mota, my Postdoctoral mentor. Their unwavering guidance and support were instrumental in shaping my path and instilling in me a profound passion for applied chemical analysis.

Professor Carlos Bendicho (University of Vigo, Spain), my esteemed doctoral mentor, was not only a source of knowledge but also a beacon of inspiration. Under his tutelage, I delved into the intricate world of chemistry, exploring its depths and applications. His mentorship went far beyond the confines of the laboratory, as he encouraged me to think critically, to question assumptions, and to approach scientific challenges with creativity and innovation. Professor Bendicho's dedication to his students and his commitment to fostering a love for chemistry were evident in his tireless efforts to nurture our intellectual growth. His mentorship equipped me with the necessary skills and ignited a deep-seated passion for the field.

After completing my doctoral studies, I had the privilege of working alongside Professor Ana Mota during my Postdoctoral research (Instituto Superior Técnico, Portugal). Professor Mota's expertise and guidance further enriched my understanding of applied chemical analysis. Her mentorship was characterized by an unwavering commitment to excellence, a meticulous approach to research, and a genuine enthusiasm for scientific discovery. Under her mentorship, I honed my research skills, delving into the intricacies of advanced analytical techniques and their real-world applications.

Professor Carlos Bendicho and Professor Ana Mota imparted valuable knowledge and served as role models of dedication and passion for their respective fields. Their mentorship extended beyond the laboratory, as they encouraged me to embrace challenges, persevere in the face of obstacles, and continuously strive for excellence. Their unwavering support and belief in my potential instilled in me the confidence to pursue a career in applied chemical analysis with zeal and determination.

BrJAC: What has changed in your profile, ambitions, and performance since the time you started your career?

Dr. Martinez: Throughout my journey as a researcher, I have not only witnessed growth in my academic and professional endeavours but, more importantly, in my development as a human being. This evolution has led me to redirect my research efforts towards areas where intellect and knowledge can be harnessed to make a profound impact on saving lives and improving the human condition.

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The quest for knowledge has been a constant driving force as a researcher. I have delved deep into various academic domains, expanded my expertise, and contributed to the scientific community. However, beyond the pursuit of academic excellence, I have come to realize that research holds the potential to bring about real-world change, particularly in the realm of healthcare and life sciences. Thus, my journey has led me to refocus my research on areas where advancements in science and technology have a direct and tangible impact on human well-being. Whether it's developing innovative medical treatments, creating sustainable solutions to global health challenges, or pioneering breakthroughs in biochemistry, my goal is to apply my intellect and skills to save lives and enhance the quality of life for people worldwide.

This transition reflects a deeper understanding of the responsibility that comes with knowledge and expertise. It's a recognition that research is not just an academic pursuit but a powerful tool for addressing

pressing societal issues. It's a commitment to using my abilities to contribute to the greater good, to extend a helping hand to those in need, and to make a meaningful difference in the lives of individuals and communities.

In conclusion, my growth as a researcher has been intrinsically linked to my growth as a human being. I have come to appreciate that research is not merely about expanding the boundaries of knowledge; it's about applying that knowledge for the betterment of humanity. Moving forward, I am dedicated to channeling my intellect, skills, and passion into research endeavors that have the potential to save lives and create a brighter, healthier future for all.

BrJAC: Could you comment briefly on the recent evolution of analytical chemistry, considering your contributions?

Dr. Martinez: Analytical chemistry, a field known for its precision and innovation, is poised to profoundly impact the world of medicine through a groundbreaking concept known as "prescriptomics." Coined by a visionary group of researchers, among whom I have the privilege to participate, this revolutionary approach is set to transform the landscape of medical diagnostics and treatment.

Applying cutting-edge analytical techniques, particularly mass spectrometry, at the heart of this transformation to analyse urine and blood samples. Mass spectrometry, with its unparalleled ability to provide detailed molecular information, is rapidly advancing in its capacity to revolutionise medical diagnostics.

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The promise of prescriptomics lies in its potential to supersede conventional diagnostic methods, including enzyme-linked immunosorbent assays (ELISAs). With the precision and sensitivity of mass spectrometry, prescriptomics can offer a comprehensive analysis of biological samples, yielding an intricate molecular profile that extends far beyond what traditional methods can provide.

Imagine a future where artificial intelligence (AI) seamlessly integrates with mass spectrometry-based analysis. In this not-so-distant reality, AI algorithms can rapidly process vast amounts of data from patient samples and generate detailed reports for physicians. These reports would not only reveal the current health status of individuals but also prescribe tailored treatment approaches with incredible precision.

Prescriptomics holds the potential to revolutionise patient care by providing healthcare professionals with real-time insights into each patient's unique molecular makeup. This information allows for highly precised personalised treatment plans, minimising the risk of adverse reactions and optimising therapeutic outcomes.

The impact of prescriptomics extends beyond diagnosis and treatment. It has the potential to reshape our approach to medicine, ushering in an era of proactive healthcare. Physicians will have the tools to detect diseases at their earliest stages, intervene before symptoms manifest, and even prevent illnesses altogether.

In conclusion, prescriptomics, driven by the power of analytical chemistry and mass spectrometry, promises to be a game-changer in medicine. It heralds a future where the analysis of urine and blood samples will not only diagnose conditions but also prescribe precise treatment strategies, ultimately advancing the goal of improving patient health and well-being.

BrJAC: What are your lines of research? You have published many scientific papers. Would you highlight any?

Dr. Martinez: Throughout my research journey, I've traversed a diverse landscape of analytical techniques, delving into various facets of science. I have explored many analytical methodologies, from atomic absorption spectrometry to mass spectrometry, from the luminescence of molecules to the intricacies of

chromatography. Today, my research is strategically focused on several compelling and impactful areas, each with unique significance in science and medicine. Recent publications in prestigious journals, such as our work featured in Nature Medical Communications, have showcased the innovative applications of our research in this domain.

One of the primary directions that has captured my attention revolves around the utilization of nanoparticles as powerful tools in medicine. These minuscule structures hold immense potential for applications in both diagnostics and therapy. Whether it's harnessing nanoparticles for targeted drug delivery, enhancing medical imaging, or combating antibiotic resistance, these tiny agents are poised to make significant contributions to healthcare.

In the realm of personalized medicine, I've been delving into the analysis of personalized proteomes. This cutting-edge approach involves deciphering the intricate web of proteins unique to each individual. By unraveling these proteomic profiles, we gain invaluable insights into an individual's health, paving the way for precision medicine. The ability to tailor medical treatments and interventions based on a patient's specific proteomic signature represents a paradigm shift in healthcare that holds great promise for improving patient outcomes.

My research portfolio has also expanded to include the analysis of archaeological and forensic proteomes, a relatively recent endeavor. This exciting line of inquiry has the potential to unlock secrets from the past and provide essential tools for modern forensic investigations.

Moreover, our contributions to the field of analytical chemistry have been notable. We've explored novel techniques, such as applying ultrasound to expedite proteome digestions with exceptional precision. These advancements enhance the speed and efficiency of proteomic analysis and contribute to the broader landscape of analytical chemistry.

In addition to these main research lines, I'm proud of our achievements in nanoparticle synthesis for biomarker discovery in diseases like myeloma and lymphomas. Our research has shed light on groundbreaking early disease detection and monitoring methods, potentially revolutionising diagnostic approaches.

Furthermore, our investigations into bacterial resistance have unveiled crucial insights. We've documented the spread of resistance to remote locations, even in areas with minimal human presence. This research underscores the urgency of addressing antibiotic resistance on a global scale and highlights the interconnectedness of human health and the environment.

As I reflect on my journey through these diverse research avenues, I am reminded of the ever-evolving nature of science and the limitless possibilities it offers. Each discovery, paper, and innovation has contributed to our collective understanding of the world and our quest to impact human health and well-being positively. In pursuing knowledge and improving society, my research endeavours continue to evolve, guided by the spirit of curiosity and discovery.

BrJAC: What is your opinion about Brazil's current chemistry research progress? What are the recent advances and challenges in scientific research in Brazil?

Dr. Martinez: Brazil has a rich history in chemistry research and has made significant contributions to various fields, including organic and natural product chemistry, materials science, and environmental chemistry. Brazilian universities and institutions have produced high-quality research and actively participated in international scientific collaborations.

The Brazilian government has also invested in scientific research through agencies like the National Council for Scientific and Technological Development (CNPq) and the Coordination for the Improvement of Higher Education Personnel (CAPES). These agencies provide funding and support for research projects, scholarships for students and researchers, and international collaboration opportunities.

This has led to one fact: from the best 10 Iberoamerican universities, 6 are from Brazil, the first is the University of São Paulo and the second one the University of Campinas.

However, challenges exist in the Brazilian research landscape, including funding constraints, infrastructure limitations, and administrative hurdles. These challenges can impact the progress and sustainability of research initiatives.

Something also worries us in Europe: the influence religion (evangelism) is gaining in science. The intelligent design, a terrible misunderstanding create by religious interest, is risking Brazilian science credit.

BrJAC: For you, what have been the most important recent achievements in analytical chemistry research? What are the landmarks? What has changed in this scenario with the COVID-19 pandemic?

Dr. Martinez: Prescriptomics is the most important one. Driven by analytical chemistry, in less than five years, artificial intelligence will be able to diagnose a disease, follow it up and check if the treatment is working. It will, in many instances, replace the physician.

Analytical chemistry is a diverse field with continuous advancements. Some recent important achievements and landmarks include advancements in mass spectrometry. Mass spectrometry techniques have become more powerful and accessible. High-resolution MS, tandem MS (MS/MS), and ion mobility MS have enabled researchers to detect and identify compounds at previously unimaginable levels of sensitivity and specificity.

Analytical chemistry has also made significant progress in the analysis of single cells, allowing for a better understanding of cellular heterogeneity and its role in various diseases, including cancer. Microfluidic devices and lab-on-a-chip technologies have advanced, making it possible to conduct complex analytical experiments on a miniaturized scale. These devices are being used for applications ranging from medical diagnostics to environmental monitoring.

Integration of different “omics” technologies like genomics, proteomics, and metabolomics has led to a more comprehensive understanding of biological systems, with implications for personalized medicine and drug discovery. The use of AI and machine learning in data analysis has become increasingly important, helping researchers make sense of the vast amount of data generated by analytical techniques.

There's also a growing emphasis on environmentally friendly analytical techniques that minimize waste generation and use fewer hazardous reagents, known as Green Analytical Chemistry. The COVID-19 pandemic accelerated the development of diagnostic tests and the deployment of analytical methods for monitoring the virus. It highlighted the importance of rapid and accurate analytical techniques in public health.

Analytical chemistry played a crucial role in the development and quality control of COVID-19 vaccines, ensuring their safety and efficacy. Furthermore, analytical chemistry continues to contribute to environmental monitoring, particularly in the detection of pollutants and the assessment of their impact on ecosystems.

These achievements underscore the ever-evolving nature of analytical chemistry and its impact on various scientific disciplines and industries. The COVID-19 pandemic has highlighted the critical role of analytical chemistry in public health and has accelerated the adoption of new technologies and methods in response to global health challenges.

BrJAC: What is the importance of awards for the development of science and new technologies?

Dr. Martinez: Awards play a pivotal role in the development of science and technology. They serve as a means of recognizing and motivating exceptional achievements, inspiring further innovation in various fields. Additionally, these accolades often come with valuable financial support, providing researchers with the necessary resources to advance their work. Furthermore, awards facilitate knowledge sharing and collaboration within the scientific community, fostering a spirit of cooperation that accelerates progress. Moreover, they help raise public awareness about significant advancements, garnering increased support and interest in science and technology. Lastly, these honors significantly boost the careers of researchers, attracting top talent and investment to further drive innovation and discovery.

BrJAC: For you, what is the importance of the national funding agencies for the scientific development of Brazil?

Dr. Martinez: National funding agencies play a crucial role in the scientific development of Brazil. They provide financial support for research projects, enabling scientists and researchers to conduct essential studies, experiments, and investigations across various disciplines. This funding is instrumental in advancing knowledge, promoting innovation, and addressing critical issues facing the country. Additionally, these agencies often foster international collaboration, allowing Brazilian researchers to connect with their global counterparts and contribute to the global scientific community. Furthermore, funding agencies help build research infrastructure and support the training of future generations of scientists, ensuring a sustainable and vibrant scientific ecosystem in Brazil.

BrJAC: At the moment, the situation for scientific research in Brazil is one of decreasing investment. How do you see this situation, and what would you say to young researchers?

Dr. Martinez: The decreasing investment in scientific research in Brazil is undoubtedly a concerning trend. It hampers the country's ability to remain competitive in the global scientific arena, hinders innovation, and affects the growth of knowledge-based industries. To young researchers, I would say, "Stay resilient and committed to your passion for science." Despite the challenges, your work can make a difference. Seek international collaborations, explore funding opportunities beyond national agencies, and advocate for the importance of science and research in your community and on a larger scale. Your dedication and contributions can help shape a brighter future for Brazilian science.

BrJAC: What advice would you give to a young scientist who wants to pursue a career in chemistry?

Dr. Martinez: I would offer advice to a young scientist aspiring to pursue a career in chemistry is to build a strong educational foundation by focusing on gaining a solid understanding of chemistry fundamentals during the academic years. This foundational knowledge will prove to be crucial throughout the career. Additionally, it is essential to develop a genuine passion for research within the field of chemistry. Find a specific area that truly interests you, and strive to become an expert in that particular domain. This passion for your research will serve as a driving force, motivating you to explore and innovate.

Another crucial aspect is seeking mentorship. Collaborating with experienced researchers who can provide guidance, support, and valuable insights is invaluable. Mentorship can significantly accelerate your career development and help you avoid common pitfalls.

Moreover, embrace continuous learning because chemistry is an ever-evolving field with new discoveries and technologies emerging regularly. Stay updated with the latest advancements by attending conferences, participating in workshops, and engaging in lifelong learning.

Building a strong network is equally important. Establish connections with your peers, mentors, and colleagues in the field of chemistry. Networking can open doors to collaborative opportunities, potential funding sources, and overall career growth.

Effective communication skills are also essential. Being able to articulate your research findings, both in writing and orally, is crucial. Clear communication enhances your ability to share knowledge, collaborate with others, and disseminate your research effectively.

Persistence and resilience are traits that will serve you well. Scientific research often involves setbacks, challenges, and failures. Don't be discouraged by these obstacles. Instead, view them as opportunities to learn and grow. Consider interdisciplinary collaborations, as many groundbreaking discoveries occur at the intersection of different scientific disciplines.

Pursuing funding opportunities is a practical step. Seek grants, scholarships, and funding sources to support your research projects. Funding is essential for conducting experiments, acquiring specialized equipment, and advancing your work.

Lastly, it is imperative to stay ethical and responsible in your research. Adhering to the highest ethical standards is vital for the credibility and integrity of scientific work.

In summary, a career in chemistry can be incredibly rewarding, contributing to solving real-world problems and advancing our understanding of the natural world. To excel in this field, maintain your curiosity, dedication, and passion for your work. With these qualities and the advice mentioned, you'll be well on your way to making meaningful contributions to the world of chemistry.

BrJAC: For what would you like to be remembered?

Dr. Martinez: For my enduring zest for life, as it is through life's journey that I continually encounter the presence of God.