

Call for Expressions of Interest to apply for a MSCA Postdoctoral Fellowship



Gastro-resistant capsules for the oral administration of lactase

The role

Lactose intolerance is a very common disorder in which individuals cannot digest lactose due to low levels of the enzyme lactase. It is estimated that 75% of adults worldwide experience hypolactasia, leading to calcium malabsorption, abdominal distension, flatulence, diarrhea, and nausea. Lactose intolerance is associated with a deficiency of lactase (β -galactosidase) in the membranes of the small intestine mucosa. Lactase catalyzes the hydrolysis of lactose (β -D-galactopyranosyl-(1 \rightarrow 4)-D-glucose) into D-glucose and D-galactose. Those who are lactose intolerant cannot hydrolyze lactase into its monosaccharide components.

Lactose intolerance can be managed by formulating lactose-free foods, ingesting lactase supplements, or inserting the encapsulated enzyme into the food matrix. **A significant challenge is the proper protection and/or encapsulation of lactase, protecting this enzyme in the stomach and controlling its release in the intestine.** The use of gastro-resistant capsules is currently the best option; however, these capsules lack the appropriate pH response. They adequately protect lactase in the stomach, but the enzyme release is delayed in the intestine.

An example of lactase encapsulation in semi-permeable gels is the use of calcium alginate capsules. This simple method efficiently incorporates lactase, preserving enzymatic activity after freezing. However, the presence of Ca^{2+} ions compromises the long-term stability of the enzyme, as it tends to denature proteins. **Consequently, further research is needed to develop hydrogel capsules that are more effective at retaining β -galactosidase while preserving its enzymatic activity.**

The research team at IQAC-CSIC recently encapsulated the protein BSA, combining water-in-water emulsion (W/W) preparation techniques with ionic complexation [Michaux et al., Food Hydrocolloids, 113 (2021), 106406]. W/W emulsions were prepared in aqueous mixtures of an anionic polyelectrolyte (sodium alginate) with BSA, obtaining BSA-in-alginate dispersions, which were introduced into polyelectrolyte capsules through the ionic complexation of sodium

alginate with Ca^{2+} and chitosan. This method has yielded gastro-resistant capsules that can release proteins in a simulated intestinal fluid [B. Zhao et al., *Colloids and Surfaces A*, 693 (2024) 133998]. **These results encourage us to pursue more detailed studies of this encapsulation method through the incorporation of a postdoctoral fellow to our group, seeking potential applications in lactase encapsulation, with the aim of transferring the technology to the pharmaceutical sector.**

What do we look for?

- **Non-Negotiable Conditions:**
 - **PhD thesis defended** at the time of deadline for applications (11th September 2024).
 - **Max. 8 years experience in research**, from the date of the award of their PhD degree.
 - **Exception:** For **nationals or long-term residents of EU Member States or Horizon Europe Associated Countries** who wish to reintegrate to Europe, years of experience in research in third countries will not be counted.
 - **Must not have resided or carried out main activity in Spain for more than 12 months between 11th September 2021 and 11th September 2024.**
- **Qualifications**
PhD in Chemistry
- **Professional experience**
Previous experience in particle synthesis and/or enzymatic reactions will be considered a plus.

Working conditions

- **Contract duration: Minimum of 12 months and maximum of 24 months.**
- Estimated annual gross salary: Stipulated by the MSCA-PF call.
- Target start date: April 2025 onwards.

The group

The Colloidal and Interfacial Chemistry (QCI) Research Group (www.iqac.csic.es/qci) is focused on the **molecular self-assembly of soft matter**, as a vehicle for the **bottom-up fabrication of nanomaterials**. The main objective is to understand and control colloidal phenomena, using singular chemical strategies, for the design and development of technological applications.

We are interested in **nanostructured systems** such as **surfactants, polymers, micelles, gels, liquid crystals, foams, microemulsions and nanoemulsions**. These systems can be used directly in the formulation and/or encapsulation of active components, or they can be used as templates, structure directing agents or nanoreactors for the synthesis of nanoparticles, nanocomposites or nanoporous solids. Through state-of-the-art techniques, we intend to understand the fundamental mechanisms of aggregation, colloidal forces and interfacial interactions and their impact on material domain size, structure, stability and other properties. We aim to use molecular information and physicochemical parameters to predict, control and program hierarchical self-organization at multiple scales and with increasing complexity, for materials with new or improved properties and applications.

The institute

The **Institute for Advanced Chemistry of Catalonia (IQAC)** is one of the research centers of the **Spanish National Research Council (CSIC)**. The Institute is located in Barcelona and it was created in 2007 with the mission to perform research of excellence in Chemical Sciences with the broad goal of improving the quality of life. The general strategy to achieve this mission involves the application of chemical approaches to address and solve societal challenges, mainly those related to human health, the sustainability of chemical processes and products, and the needs for novel materials for different applications. Since its establishment, IQAC has been in a permanent attitude to transfer its knowledge and technology results to the industrial sector.

The research developed at IQAC is organized around two main nodes: **Biological Chemistry** and **Nanobiotechnology** and it is facilitated by a number of Key Enabling Technologies. Considering the objectives pursued, many of the investigations carried out by the Research Groups at IQAC lie at the intersection between nodes.

In addition, our Institute holds a set of scientific and technical facilities run by highly qualified scientists and technical personnel with a solid background and long lasting expertise. These facilities are available not only to IQAC research groups, but also to potential users from both academia and private institutions. In any case, the technical services from IQAC are always wide open to attend any inquiry and to offer their best efforts to find adequate responses to specific needs.

How to apply?

Those interested may email their **CV** and **motivation letter** to **Jordi Esquena**, at jordi.esquena@iqac.csic.es with CC to international@iqac.csic.es, adding "**MSCA Postdoctoral Fellowship**" to the email subject and indicating via which channel you found the expression of interest. **Letter/s of references are recommended.**

Deadline: 23th July 2024.