Virtual BSC RS/Life Session: Using computers to understand how carbohydrates are processed in nature

Objectives

Abstract: Carbohydrate-active enzymes (CAZymes), such as glycoside hydrolases and glycosyltransferases, constitute the main machinery for the degradation, synthesis and modification of carbohydrates in nature. They have a myriad of industrial and biotechnological applications, ranging from biofuel production to biotherapeutics. In recent years, new CAZyme structures have been solved that pose mechanistic questions on how their carbohydrate substrates are processed, such as the identity of the catalytic residues, the role of enzyme conformational transitions and the distortion of the substrate at the transition state of the chemical reaction. Using state-of-art simulation techniques such as ab initio quantum mechanics/molecular mechanics (QM/MM) and metadynamics [1-3] we have contributed to answer these questions, providing an atomistic view of enzyme action that can guide inhibitor design. In this talk I will describe some of the CAZyme mechanisms that we have recently investigated [4-6], in a collaborative work with research groups of structural and chemical biology.

[1] Laio, A.; Parrinello, M. Proc. Nat. Acad. Sci. U.S.A. 2002, 99, 12562-12566.

[2] Ardèvol, A.; Rovira, C. J. Am. Chem. Soc. 2015, 137, 7528-7547.

[3] J. Coines, L. Raich, C. Rovira. Curr. Opin. Chem. Biol. 2019, 53, 183-191.

[4] L. F. Sobala, G. Speciale, S. Zhu, L. Raich, N. Sannikova, A. J. Thompson, Z. Hakki, D. Lu, Y. Zhang, S. S. K. Abadi, A. R. Lewis, V. Rojas-Cervellera, G. Bernardo-Seisdedos, O. Millet, J. Jime?nez-Barbero, A. J. Bennet, M. Sollogoub, C. Rovira, G. J Davies, S. J. Williams, ACS Cent. Sci. 2020, 6, 760–770.

[5] M. K. Bilyard, H. Bailey, L. Raich, M. Gafitescu, T. Machida, J. Iglesias-Fernández, S. S. Lee, C. D. Spicer, C. Rovira, W. W. Yue, B. G. Davis, Nature 2018, 563, 235–240.

[6] M. A. B. Morais, J. Coines, M. N. Domingues, R. A. S. Pirolla, C. C. C. Tonoli, C. R. Santos, J. B. L. Correa, F. C. Gozzo, C. Rovira, M. T. Murakami. Nat. Commun. 2021, 12, 367.

Carme obtained her PhD degree in Chemistry from the University of Barcelona in 1995. During PhD, she did long research stays at North Carolina State University and Southern Illinois University (USA). After her PhD she was Marie-Curie postdoctoral fellow at the Max-Planck-Institute of Stuttgart, Germany (1996-1998), working with Michele Parrinello. She then obtained a 5-years Ramón y Cajal position and started her independent research group in Barcelona. Carme was appointed ICREA Research Professor in 2007. In 2019 she was visiting Professor at the University of York (UK).

Speakers

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