"Understanding Hydrolysis, Aggregation, and Functioning of Biomolecules Through Computational Approaches"

Recent developments in computational hardware and software led to the investigation of complex biological systems through computational calculations. Computational studies started to provide invaluable answers to everlasting questions, which could not be understood by any other experimental techniques.[1-3] The scientific community also recognized the value of computational calculations on biological systems and this young field field was awarded with the Nobel Prize in Chemistry in 2013.[4]

This talk will be based on plethora of theoretical and computational techniques involving quantum mechanics (QM), molecular dynamics (MD), and molecular docking to understand the functioning of complex biological systems and biomolecules. Goals of the studies discussed in this talk are elucidation of peptide degradation mechanisms by insulin degrading enzyme (IDE), neprilysin (NEP), and their synthetic analogues;[5,6] altering and enhancing the functioning of IDE, NEP, and indole-3-glycerol-phosphate synthase (IGPS); understanding the aggregation of small biomolecules (insulin and amyloid beta (Aβ) peptides);[7,8] and shedding light on the mechanism of smelling by human olfactory receptor,[9] ion transport by *influenza A* virus, P-type ATPases, and *Neisseria meningiditis* at the molecular level. These studies answer fundamental questions on the mechanisms of human diseases such as Alzheimer`s disease, Type II Diabetes, influenza, meningitis.

References:

1. Cramer, C.J. "Essentials of Computational Chemistry", *John Wiley & Sons*, 2002.
2. Karplus, M., McCammon, J.A. *Nature Struc. & Mol. Biol*., 2002, *9*, 646.
3. Ozbil, M., Barman, A., Bora, R.P., and Prabhakar, R. *J. Phys. Chem. Lett*., 2012, *3*, 3460.
4. "The Nobel Prize in Chemistry 2013". *Nobelprize.org*, 2014.
5. Bora, R.P., Ozbil,M., Prabhakar, R. *J. Biol. Inorg. Chem.,* 2010*, 15*,485, 2010.
6. Bora, R.P, Barman,A., Zhu,X., Ozbil,M., and Prabhakar,R. *J. Phys. Chem. B,* 2010, *114*,10860.
7. Kurouski, D., Washington, J., Ozbil, M., Prabhakar, R., Shekhtman, A., and Lednev, I., "Disulfide Bridges Remain Intact While Native Insulin Converts into Amyloid Fibrils". *PLoS ONE*, 2012, *7(6)*, e36989.
8. Cook, N.P., Ozbil, M., Katsampes, C., Prabhakar, R., and Martí, A.A. *J. Am. Chem. Soc*. 2013, *135*, 10810.
9. Sekharan, S., Ozbil, M., Ertem, M.Z., Ten, N., Pan, Y., Zhang, R., Zhuang, H., Block, E., Matsunami, H., and Batista, V.S. *Angew. Chem. Int. Ed.,* submitted, 2015.