

## Abstract

Analysis and quantification of organophosphate pesticides (OP)-protein interaction draw major attention in the field of agrochemicals. Such molecular interactions have a significant role to play in the agro-ecosystem by affecting the non-target organisms. The current thesis aims to investigate OP-protein interactions using solution-state 1D  $^1\text{H}$  NMR spectroscopy as a major technique complemented by fluorescence quenching studies, molecular docking, and Isothermal Titration Calorimetry (ITC), whenever required.

The first part of the thesis considers the interaction of OP and its metabolites with model protein Bovine Serum Albumin (BSA) employing  $^1\text{H}$  Saturation Transfer Difference (STD) NMR and selective  $^1\text{H}$  spin-lattice relaxation rate measurements methods. The analysis of experimental NMR data supported by molecular docking and ITC clearly indicated structure dependence of such molecular interaction, especially in the case of halogenated ligands. The highest binding affinity was exhibited by halogen-containing OP that pointed out the involvement of halogen bonding. Moreover, a pseudo-esterase activity was observed for BSA in the case of OP oxons.

In the second part of the thesis, the interaction of OP and their metabolites with gut enzyme trypsin in terms of the binding strength. The experimental data enabled the extraction of quantitative parameters of such interactions in terms of binding strength, thermodynamic parameters, and their binding modes. Also, the alteration in trypsin activity was monitored in the presence of OP. In a nutshell, this thesis extends the applicability of in-vitro ligand-based solution-state  $^1\text{H}$  NMR methods with potential widespread application to characterize and understand the OP-protein interaction. The robustness emphasizes the conventional approach and future advantage of NMR application with computational methods, tailored to specific protein classes.

...

