KN-6 Structure of a bacterial α-macroglobulin reveals mimicry of eukaryotic innate immunity

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Alpha-2-macroglobulins (A2Ms) are plasma proteins that trap and inhibit a broad range of proteases and are major components of the eukaryotic innate immune system. Surprisingly, A2M-like proteins were identified in pathogenically invasive bacteria and species that colonize higher eukaryotes. Bacterial A2Ms are located in the periplasm where they are believed to provide protection to the cell by trapping external proteases through a covalent interaction with an activated thioester. Our work reveals the crystal structures and characterization of *Salmonella typhimurium* A2M in different states of thioester activation. The structures reveal thirteen domains whose arrangement displays high similarity to proteins involved in eukaryotic immune defense. A structural lock mechanism maintains the stability of the buried thioester, a requirement for its protease trapping activity. These findings indicate that bacteria have developed a rudimentary innate immune system whose mechanism mimics that of eukaryotes.

Keywords: bacterial infection, immunity, macroglobulin, crystal structure

KN-7 Solving chemistry puzzles in molecules and crystals through charge and spin density analyses

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Being based on a quantum observable and (easily) measurable quantity, the Electron Density (ED) based descriptors retain the great advantage of enabling a comparison of theoretical predictions with experimental results on the same grounds, and regardless of the specific tools used to obtain the observable itself. EDs derived from X-Ray structure factors or from *in vacuo* and in crystal wavefunctions will be considered during the talk.
On top of customarily used ED topological descriptors [1], this lecture will mostly focus on the Source Function (SF) tool [2,3], and on the Reduced Density Gradient analysis, introduced by Johnson [4] as a convenient instrument to characterize non covalent interactions (NCIs) *in vacuo* (and recently also made available for [5] and applied to [6-7] NCIs in crystals). The SF enables one to view chemical bonding and other chemical paradigms under a new perspective [3]. Its extension [8] to the electron spin density (ESD) provides special insights on how spin information is transmitted from paramagnetic to non-magnetic centers. Use of the mentioned ED-based descriptors to help solving chemistry puzzles, like the issue of S hypervalency in the $[SO_4]^{2-}$ anion [9], the NC bond length inversion in a thiazete-1,1-dioxide crystal [10], the detection of electron correlation effects [11] and of NCIs nature in molecular organic crystals [5-6] and the distinction of *magnetic* from *relaxation* contributions in ESD transmission [8] will be shown.

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