ENGINEERING AND BIOCATALYSIS OF FLAVIN-RELATED SYSTEMS TO SUPPORT SUSTAINABILITY

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Our group interests are in the broad areas of enzyme catalysis, enzyme engineering, systems biocatalysis, metabolic engineering and synthetic biology. In this talk, I will highlight our recent and current work on investigation of halogenase, dehalogenase and electron boosting systems which leads to applications in biocatalysis, detection technology and hydrogen production. We used mechanistic understanding and rational-engineering to improve performance of a flavin-dependent halogenase and also reroute reactions of selected flavin-dependent monooxygenases to perform non-native reactions. The second system is a showcase of incorporation an electron boosting system to enhance hydrogen production. We also developed of an enzymatic cascade and engineering of a flavin-dependent monooxygenase, HadA, which catalyzes the dehalogenation and denitration of the toxicants, nitro- and halogenated phenols, to benzoquinone. The HadA reaction was applied in one-pot reactions towards the *de novo* synthesis of D-luciferin. Currently, this technology allows us to develop a new method for synthesizing various D-luciferin analogues. As nitro- and halogenated phenols are key indicators of human overexposure to pesticides commonly used worldwide and indicators of pesticide contamination, the technology provides a sensitive and convenient tool for biomedical and environmental detection at ppb sensitivity in biological samples without the requirement for any pre-treatment.