**ABSTRACT**

Heme-enzymes are ubiquitous and versatile redox enzymes that play integral roles in several cellular processes. Activations and inhibitions of hemoproteins by several additives have been attributed to alterations in the enzymes’ catalytic sites and have been considered under the purview of classical paradigms hitherto available.

*In vitro* reaction outcomes of activations and inhibitions are reported herein upon the inclusion of classical type II binders like azide, amitrol and phenylhydrazine, in wide concentration ranges of $10^{-3}$ to $10^{-12}$ M. The profiles varied at reaction regimes for various enzyme-substrate-additive-pH combinations. These unusual dose-response profiles cannot be explained using hitherto available classical kinetic paradigms. A more probable mechanism involving diffusible radical mediated processes and multiple competing reactions in the reaction milieu affords satisfactory explanations for the observed modulations. Ramifications of the findings mentioned above were evident in stored additive-mediated reaction modulations and in other related (in *situ* and physiological) scenarios.

*In situ*, inclusion of the broken N-terminal transmembrane peptide portion of CYPs’ diflavoenzyme redox partner, cytochrome P450 reductase (CPR) is known to result in the inhibition of Cytochrome P450 (CYP) reactions. Workers attributed it to putative roles of N-terms of CYP & CPR in protein-protein interactions and hence, obligatory roles in catalysis. *In silico* analysis of interactions between the transmembrane helices of CYP-CPR showed little scope for protein-protein complexations (mediated via N-termini) in effecting P450 reactions. Besides facilitating the anchoring of CPR within the microsomal membrane, the N-term of CPR modulates DROS (Diffusible Reduced Oxygen Species) *in milieu*.

Additives that showed unusual dose response profiles of heme-enzymes were presented to some bacterial cultures. Additive-based effects were also probed with the over-expression of some redox-active proteins. A chemical grounding to the complex, and as yet unexplained phenomenon of hormesis (a dilute concentration being more effective than a concentrated solution) is derived for the first time.