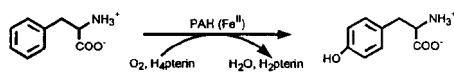
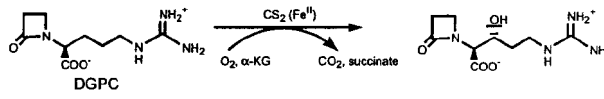
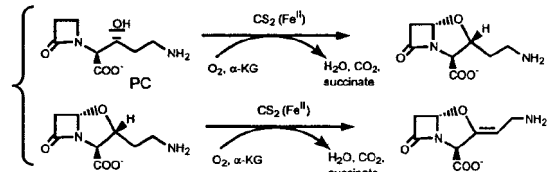
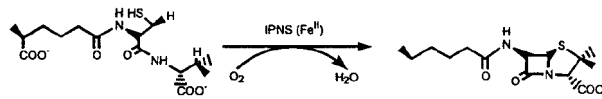
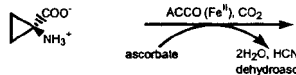
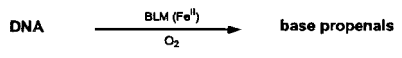
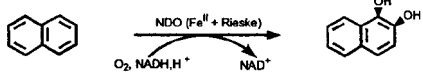
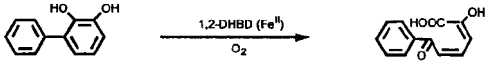
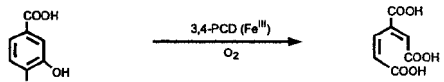
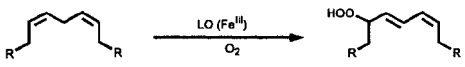


# Non-Heme Fe Reactions involving Dioxygen

Table 1. Mononuclear non-heme iron enzymes

Reaction type	Rep. enzyme/Xtal structure ref.	Catalytic reaction
<b>Fe<sup>II</sup>/O<sub>2</sub> Activation</b>		
pterin-dependent hydroxylation	phenylalanine hydroxylase (4)	
α-ketoglutarate-dependent hydroxylation	clavaminate synthase (5)	
α-ketoglutarate-dependent 4e <sup>-</sup> oxidation	clavaminate synthase	
4e <sup>-</sup> oxidative ring closure	isopenicillin N-synthase (6)	
ascorbate-dependent 2e <sup>-</sup> oxidation	l-aminocyclopropane carboxylic acid oxidase	
H• abstraction	Bleomycin	
cis-hydroxylation	naphthalene 1,2-dioxygenase (7)	
extradiol dioxygenation	dihydroxybiphenyl dioxygenase (9)	
<b>Fe<sup>III</sup>/Substrate Activation</b>		
intradiol dioxygenation	protocatechuate 3,4-dioxygenase (10)	
hydroperoxidation	lipoxygenases (8)	

Edward I. Solomon<sup>†</sup>, Andrea Decker, and Nicolai Lehnert

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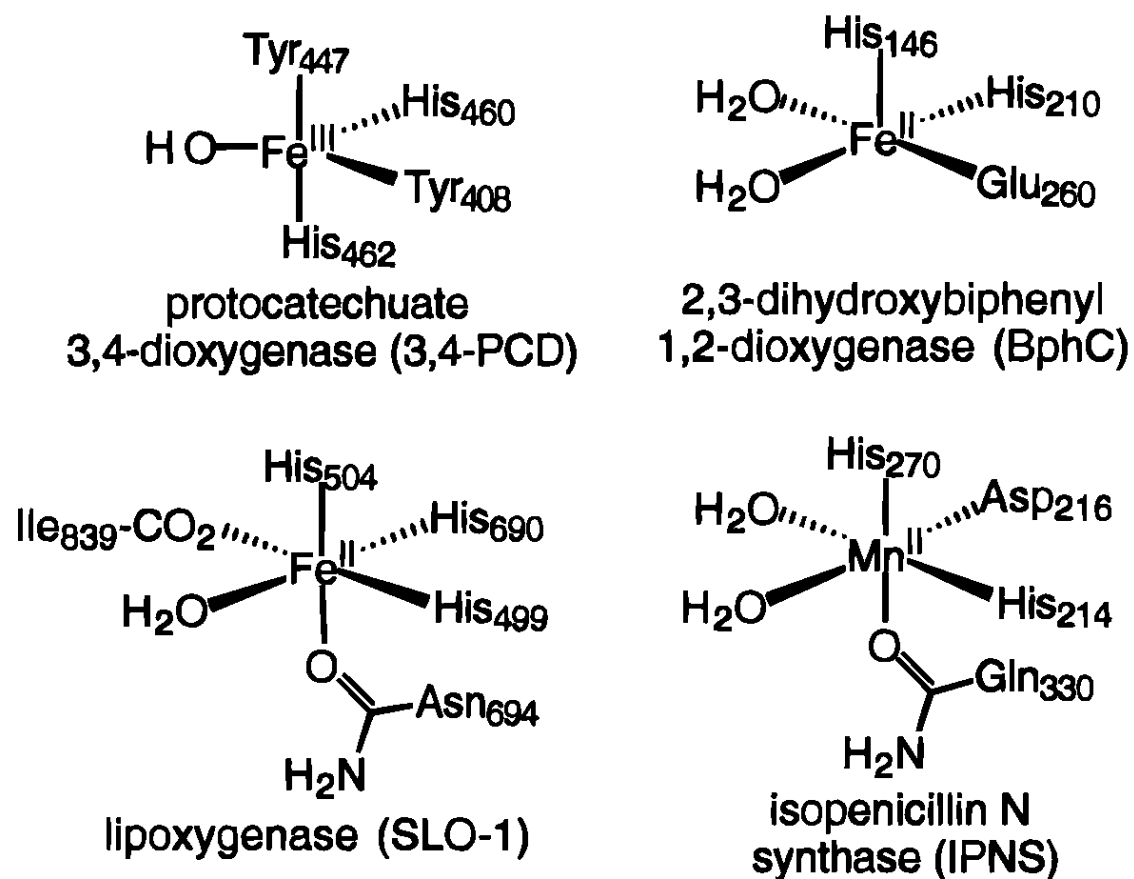
# Non-heme Fe oxygenases

**Table 1. Summary of Information about the Mononuclear Non-Heme Iron Enzymes**

enzyme	requirement for activity	endogenous ligand set	coordination no. and geometry	functional models
catechol dioxygenase-intradiol cleavage	Fe(III) bound catechol	2 Tyr, 2 His	CN = 5 trigonal bipyramid	[Fe(TPA)(DBC)] <sup>+</sup> 15
catechol dioxygenase-extradiol cleavage	Fe(II) bound catechol	2 His, Glu	CN = 5 square pyramid	[Fe(TACN)(DBC)Cl] <sup>+</sup> 16
lipoxygenase	Fe(III)	3 His, Ile-CO <sub>2</sub> <sup>-</sup> , Asn	CN = 6 distorted octahedral	[Fe(6-Me <sub>3</sub> -TPA)(O <sub>2</sub> CC <sub>6</sub> H <sub>5</sub> )] <sup>+</sup> 17
IPNS α-keto acid-dependent enzymes	Fe(II) bound ACV Fe(II) α-keto acid	2 His, Asp, Gln NA <sup>a</sup>	CN = 6 distorted octahedral NA <sup>a</sup>	[Fe(TPA)(SPh)] <sup>+</sup> 18 [Fe(6-Me <sub>3</sub> -TPA)(BF)] <sup>+</sup> 19 Fe(Tp <sup>3,5-Me<sub>2</sub></sup> )(BF) 20
Rieske oxygenases	Fe(II) Fe <sub>2</sub> S <sub>2</sub> cluster NADH	NA <sup>a</sup>	NA <sup>a</sup>	NA <sup>a</sup>
bleomycin <sup>b</sup>	Fe(II) reducing agent	5 nitrogen ligands	CN = 5 square pyramid	[Fe <sup>II</sup> (PMA)] <sup>+</sup> 21

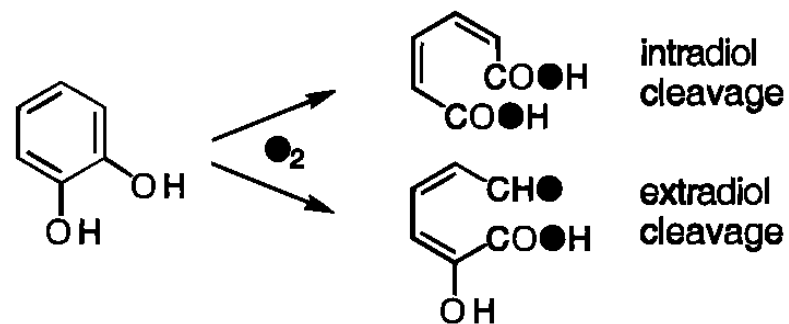
<sup>a</sup> Information is currently unavailable. <sup>b</sup> A natural product, used as an antitumor drug.

## Non-heme Fe oxygenases (cont.)

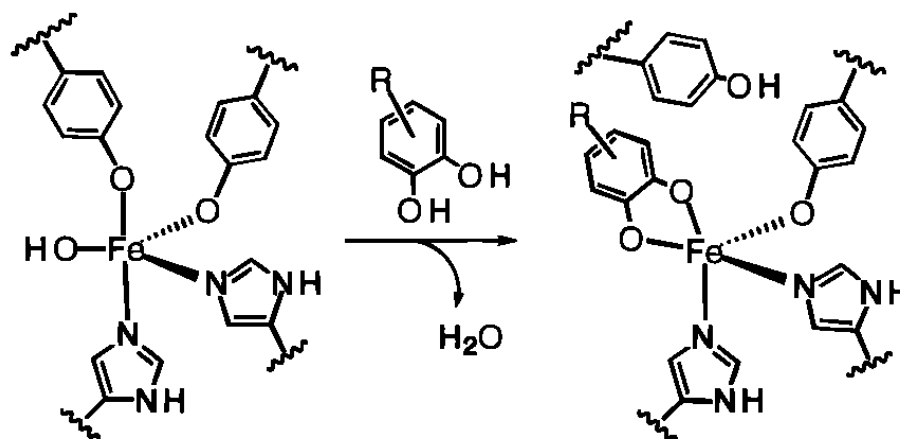


**Figure 1.** Metal coordination sites of the four crystallographically characterized mononuclear non-heme iron enzymes.

# Non-heme Fe oxygenases (cont.)

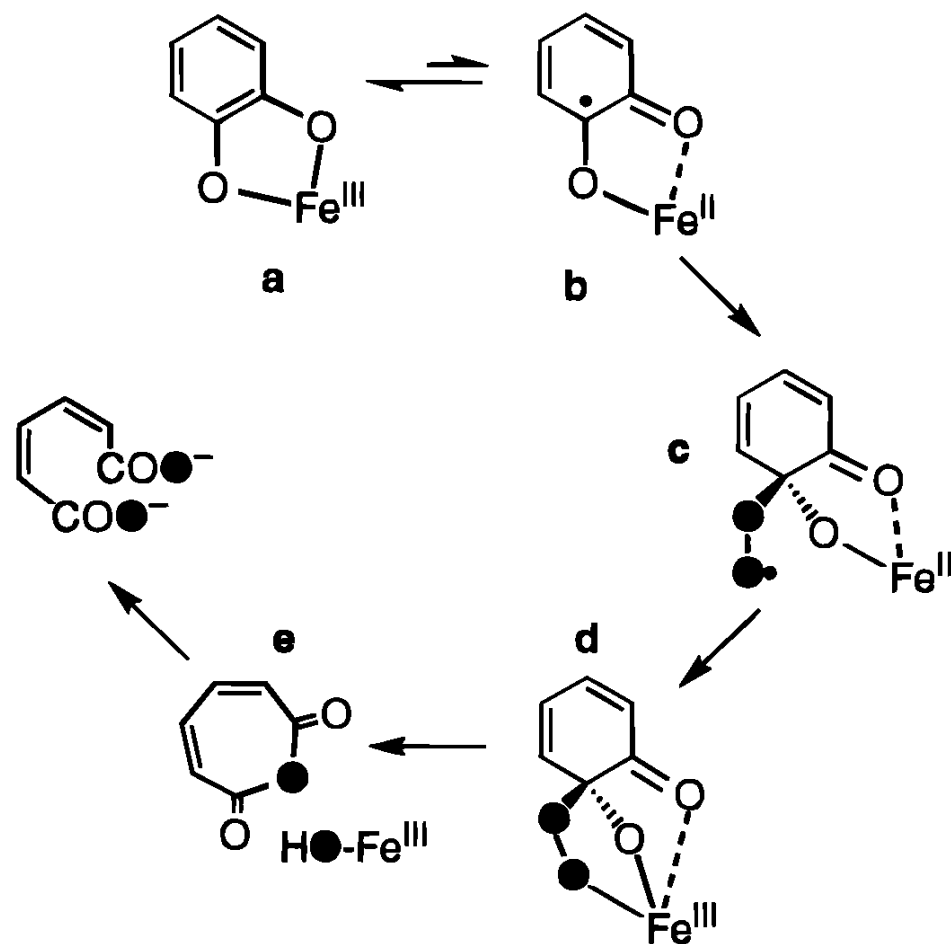


**Figure 2.** Modes of catechol cleavage.



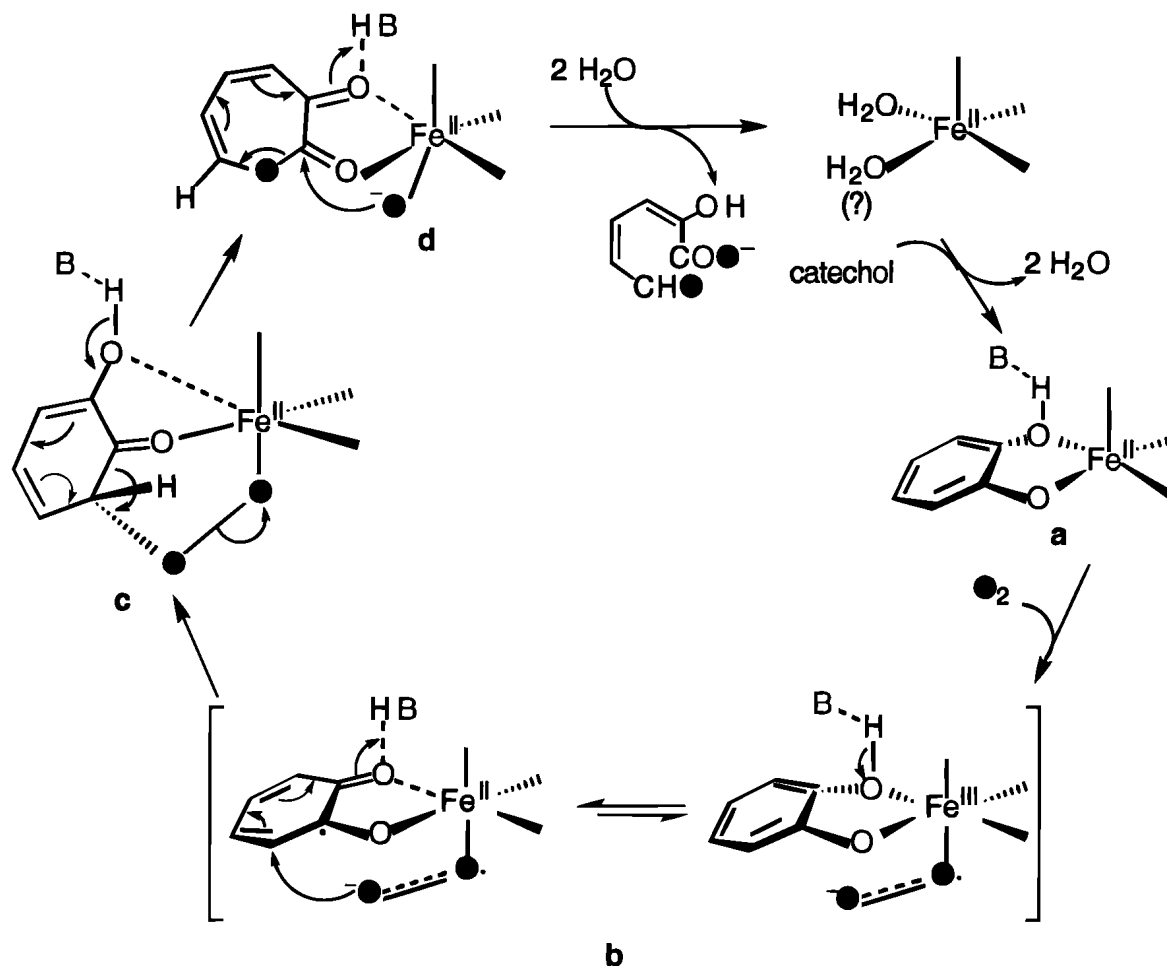
**Figure 3.** The proposed binding of substrate to proto-catechuate 3,4-dioxygenase.

## Non-heme Fe oxygenases (cont.)



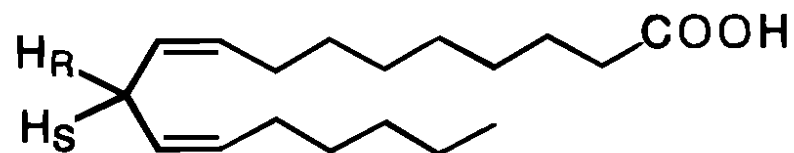
**Figure 5.** Proposed substrate activation mechanism for the intradiol-cleaving catechol dioxygenases.

# Non-heme Fe oxygenases (cont.)

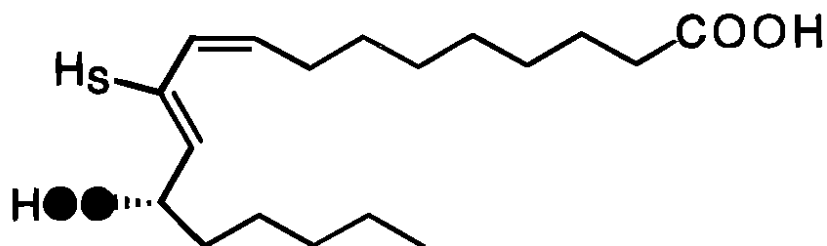
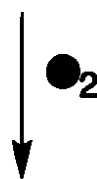


**Figure 8.** Proposed mechanism for the extradiol cleavage of catechol.

# Lipoxygenase



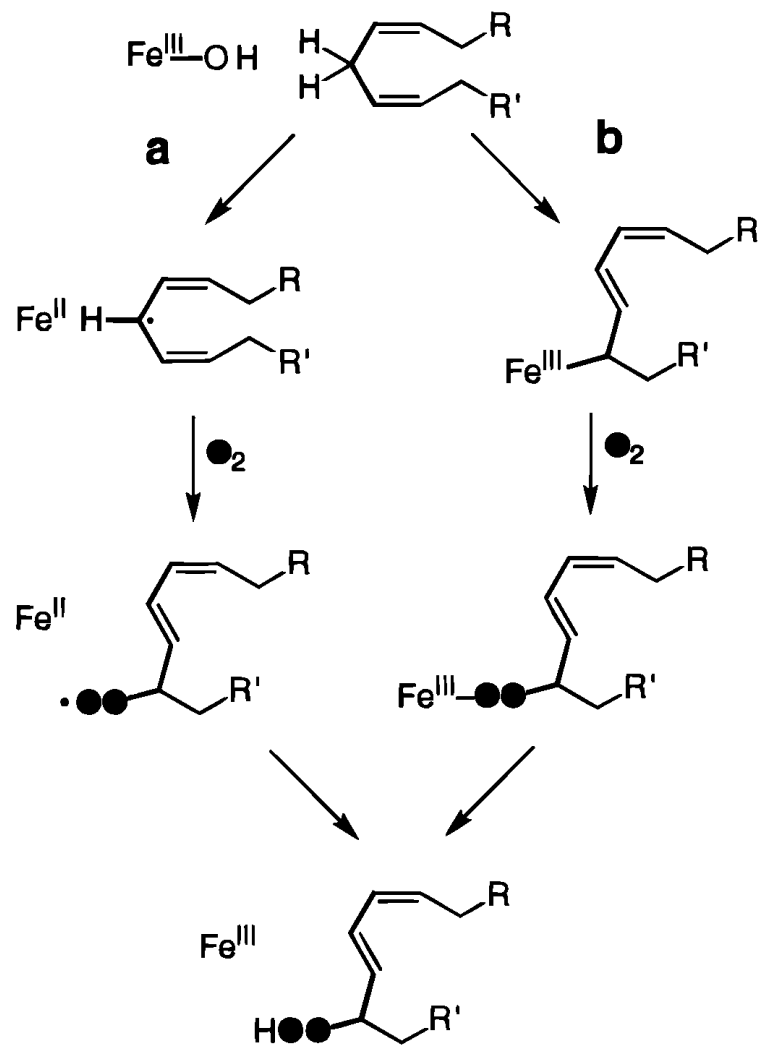
Linoleic acid



**Figure 11.** Enzymatic reaction of soybean lipoxygenase-1.

# Lipoxygenase Mechanism?

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**Figure 13.** Proposed enzymatic mechanism for lipoxygenase.