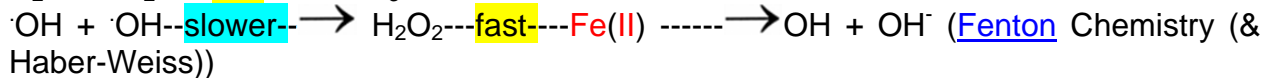
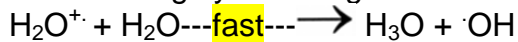
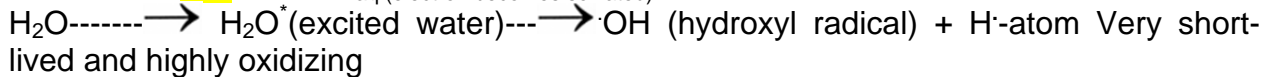
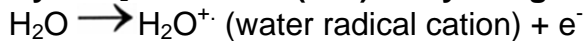
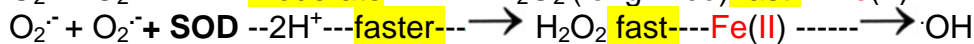
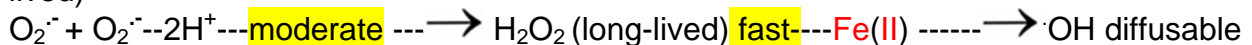
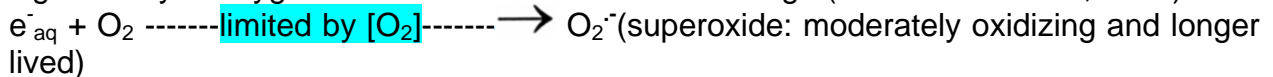


## Hydroxyl Radicals ( $\cdot\text{OH}$ ): Very Dangerous to All Biomolecules



**Superoxide ( $\text{O}_2^{\cdot-}$ ):** Substantially less oxidizing and not considered to contribute significantly to oxygen enhancement of radiation damage (Misra & Fridovich, 1976)



**Role of  $\text{Mn}^{2+}$ :** Powerful Scavenger of superoxide ( $\text{O}_2^{\cdot-}$ ) and does not catalyse  $\cdot\text{OH}$  formation from  $\text{H}_2\text{O}_2$

## Metabolism-Induced ROS are Dangerous

The most important source of ROS *in vivo* in aerobic bacterial cells is the electron transport chain, that can give rise to high levels of  $\text{O}_2^{\cdot-}$  which is rapidly converted to  $\text{H}_2\text{O}_2$  by dismutation.



Electron Transport systems leak electrons directly on to  $\text{O}_2$ , yielding superoxide

Following return-to-growth, electron leaks may be greater

Normal *E. coli* generates 5 mM  $\text{O}_2^{\cdot-}$  per second in rich medium yielding steady-state 0.1-0.2 mM  $\text{H}_2\text{O}_2$ , & Much higher in minimal medium.

SOD mutants of *E. coli* (*sodA<sup>-</sup>B<sup>-</sup>*) cannot grow in minimal medium where high levels of metabolic ROS are generated; and recombination deficient (*recA<sup>-</sup>*) *E. coli* *sod* mutants are killed in all aerobic growth conditions.

*D. radiodurans* (*sodA<sup>-</sup>[B<sup>-</sup>]*) grows on MM and under chronic radiation

*D. radiodurans* (*sodA<sup>-</sup>[B<sup>-</sup>] recA<sup>-</sup>*) is viable under aerobic conditions

Irradiation : Releases Fe(II) from proteins, in the absence of Fe(II) causes  $\text{H}_2\text{O}_2$  accumulation; protein-, lipid-, and DNA-damage