

# Macromolecular Crystallography Unit

Master Project – ITQB 2010

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**Title:** *Structural studies on Superoxide reductases*

**Abstract:** A Master project is proposed to carry out structural studies of superoxide reductases, an important biological system involved in the protection against oxidative damage in prokaryotes.

**Introduction:**

Although dioxygen ( $O_2$ ) molecule is relatively inert, it can be rapidly converted into reactive species, through the formation of a one-electron reduction product, superoxide anion ( $O_2^-$ ). This species can be further reduced in a one-electron cascade reduction, forming two reactive species: hydrogen peroxide ( $H_2O_2$ ) and the hydroxyl anion ( $OH^-$ ). The adaptation of ancient microbes to aerobic habitats involved the evolution of enzymes responsible for scavenging reactive oxygen species (by-products of aerobic metabolism) [1]. In anaerobic organisms, the presence of these enzymes is also known, since they may have to deal transiently with oxygen.

The best known enzymatic systems are the superoxide dismutases (SODs) ( $O_2^- \rightarrow H_2O_2$ ) and peroxidases ( $H_2O_2 \rightarrow H_2O$ ). Besides these systems, another type of protein has been studied in recent years, the superoxide reductases (SORs), which detoxify the superoxide anion through its reduction to hydrogen peroxide. The two types of enzymes, SODs and SORs, operate by distinct mechanisms. Although they share a common step, the  $O_2^-$  reduction, SOD enzymes are also able to catalyse the oxidation of  $O_2^-$ , whereas SOR enzymes are not [2], and the reasons for these different reactivities are still unclear. Using Macromolecular Crystallography we aim to study SOR enzymes from different prokaryotes. These studies will contribute to elucidate their mechanism of reaction.

This work will involve the collaboration with Prof. Miguel Teixeira, leader of the Metalloenzymes and Molecular Bioenergetics Group.

[1] Imlay J.A. (2008) Cellular Defenses against Superoxide and Hydrogen Peroxide *Annu. Rev. Biochem.* **77**, 755–76

[2] Pinto A.F., Rodrigues J.V., Teixeira M. (2010) Reductive elimination of superoxide: Structure and mechanism of superoxide reductase *Biochem Biophys Acta* **1804**, 285-97.

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