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Studies in Protein Structure:  
The structure and properties of the iron superoxide  
dismutase from *Methanobacterium thermoautotrophicum*.  
The structures of  $\beta$ -lactoglobulin in two new crystal  
forms.

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A dissertation  
submitted in partial fulfillment  
of the requirements for the degree  
of  
Doctor of Philosophy  
in the  
Institute of Fundamental Sciences  
at  
Massey University  
by  
Julian James Adams

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**Massey University**

**2002**

“If the going is tough and the pressure is on; if reserves of strength have been drained and the summit still not in sight, then the quality to seek in a person is neither great strength nor quickness of hand, but rather a resolute mind firmly set on its purpose that refuses to let its body slacken or rest.”

**Sir Edmund Hillary.**

## ABSTRACT

Studies in Protein Structure:

The structures of  $\beta$ -lactoglobulin in two new crystal forms.

The structure and properties of the iron superoxide dismutase from

*Methanobacterium thermoautotrophicum*.

By

Julian James Adams

The crystal structure of *Methanobacterium thermoautotrophicum* iron superoxide dismutase (*Mt*-FeSOD) has been determined by X-ray diffraction to a resolution of 2.6 Å. The crystals were grown from PEG 6000 at a pH of 5.5, and the structure was solved by molecular replacement. The structure, in concert with structural and functional data from other Fe and Mn SODs, provides insights into aspects of metal specificity, reactivity of superoxide dismutase towards toward the inhibitor azide and deactivator hydrogen peroxide, and how the primary structure is involved in subtle tuning of these properties. The structure reveals how the protein is designed for thermal and chemical stability, yet retains moderate superoxide dismutase activity at ambient temperature.

Bovine  $\beta$ -lactoglobulin (BLG) has been studied for many decades; numerous X-ray and NMR structures are available. Here we present two

new X-ray structures, one from a crystal grown at very low ionic strength, and at the lowest pH ( $\sim 5.2$ ) of any X-ray structure. This structure provides validation of the other, high ionic strength X-ray structures. The core elements of BLG, an eight-stranded  $\beta$ -barrel, a three-turn  $\alpha$ -helix external to the barrel, and an external  $\beta$ -strand (that forms the dimeric interface), are almost invariant across all structures. Four flexible loops have a variety of positions in the known structures and this represents a set of snapshots of the *in vivo* states of BLG. These flexible loops play an important role in the entropic stabilization of the  $\beta$ -barrel.

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**PUBLICATIONS**

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