

17 INTRODUCTION

The essential role of iron for the human organism was recognised in antiquity, whence legend (and a recent review¹) records that a glass of wine and rust was sufficient to cure sexual impotence and to benefit those who, unfortunately, could not 'cohabit properly'. A complete understanding of these remarkable phenomena still escapes contemporary biochemistry, and even bioinorganic chemistry, yet, of all the essential trace metals, iron and its biological functions are probably the best understood. Many of these functions depend on the aqueous chemistry of iron(III), which is now known to be dominated by hydrolysis and polymerisation, with the formation of polynuclear iron(III) species, that is species that contain at least two iron atoms interacting via some bonding arrangement. This review discusses the results of structural studies, using a variety of physical methods, on a number of proteins that bind a large number (≥ 50) of iron(III) ions in a polynuclear fashion. Many of these studies have been carried out since 1969, when this research field was the subject of an excellent review¹.

Several proteins that bind more than one mole of iron per mole of protein are not included in this review. Transferrin binds two iron(III) ions but they appear to be sufficiently distant for no polynuclear interaction to occur²⁻⁴. Hemerythrin, which has been shown to contain antiferromagnetically coupled iron(III) ions⁵⁻⁷, is considered elsewhere. Nonhaem iron-sulphur proteins, for example ferredoxins⁸, will also not be considered here.

Part 4 is organised in the following way. The presently available information on the hydrolytic polymerisation of iron(III) is summarised briefly in chapter 18. Chapter 19 considers the strengths and weaknesses of various experimental techniques used in studies of polynuclear iron(III) proteins, with particular emphasis on their application to model iron(III) compounds. Following consideration in chapter 20 of the several biological roles of polynuclear iron(III), chapter 21 discusses the structural results obtained for a number of biological systems. Finally a biological perspective of these studies is presented in chapter 22.