BIOCHEMICAL JOURNAL LETTERS

The identity of bacterioferritin and cytochrome b_1

Cytochrome b_1 which was isolated from *Escherichia coli* by Deeb & Hager (1964) contained one molecule of haem per 66000 Da of protein. On the basis of this and a subsequent publication (Hager & Deeb, 1967), the molecule of cytochrome b_1 is now considered to be an assembly of eight subunits and of a mass of 500000 Da (Hagihara *et al.*, 1975). Recently, what appeared to be a novel kind of cytochrome has been isolated from *E. coli* and two *Azotobacter* species and named bacterioferritin (Stiefel & Watt, 1979; Jiudi *et al.*, 1980; Yariv *et al.*, 1981; Chen & Crichton, 1982).

Bacterioferritin and cytochrome b_1 are both isolated in the oxidized form and have the same optical spectra. On reduction, the maxima, in both cases, are shifted to the same wavelengths. Bacterioferritin and cytochrome b_1 have the same redox potential and are of the same size. The mass of bacterioferritin subunit was found to be, by gel electrophoresis in sodium dodecyl sulphate, 15000 Da in *E. coli* and 17000 Da in the two *Azotobacter* species studied. No comparable estimate of subunit size is available for the isolated cytochrome b_1 . Thus there is nothing to distinguish bacterioferritin from cytochrome b_1 and therefore the last and older name should be preferred. The new name is useful in that it points out the similarity in structure between cytochrome b_1 and ferritin. Ferritin is a molecule composed of 24 identical subunits which are related by 432 symmetry and form a shell around a central cavity (Banyard *et al.*, 1978). At low resolution (down to 0.7 nm) this is true of bacterioferritin as well. It is significant, even if the mechanism is obscure, that both these structures can have the central cavity filled with a polynuclear iron compound. Does it mean that in bacteria cytochrome b_1 has two unrelated functions, of cytochrome and of ferritin, or are the two functions somehow related? On the structural level there is the fascinating and unresolved problem of the low occupancy of haem binding sites (potentially 24) which has misled reviewers into believing that the M_r of the subunit of cytochrome b_1 is 60000 where in fact it is 15000.

Cytochrome b_1 is supposed to be associated in the bacterial membrane with other components of the

electron transport system and in *E. coli* exhibits slightly different absorption maxima when bacteria are grown on different substrates (Haddock & Jones, 1977). One would like to be able to account for these spectroscopic and functional differences of cytochrome b_1 by structural information. It would be hasty to conclude that the structure of a ball, which is to a first approximation the structure of cytochrome b_1 in solution, must be the form in which this ubiquitous protein exists in the membrane. There are certain lessons to be learned from the structure of ferritin which suggest that cytochrome b_1 may exist in the membrane as a component smaller than the 24-mer molecule. The highly symmetrical ferritin structure favours assembly from certain oligomers, such as dimers and hexamers, and suggests that other oligomers, such as trimers and tetramers, are unlikely. In cytochrome b_1 , as well, a certain oligomer is bound to be preferred over other assemblies of the subunit.

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