Short Communication

Similarities between Soluble Inorganic Pyrophosphatase from Yeast and some Nucleotide-Binding Polypeptides*

Herrick Baltscheffsky,§ Mohamed Alauddin, Gunnar Falk and Maria Lundin

Department of Biochemistry, Arrhenius Laboratory, University of Stockholm, S-106 91 Stockholm, Sweden


Inorganic pyrophosphate (PPi) is an alternative to ATP in the energy conversion reactions of chromatophore membranes from the purple non-sulfur photosynthetic bacterium Rhodospirillum rubrum. The chromatophores contain an uncoupler-stimulated inorganic pyrophosphatase (PPase).1,2 They show light-induced formation of PPI3,4 and PPI-driven energy-requiring reactions.5,7 A proton-pumping PPI synthase from chromatophores has been solubilized and partially purified and characterized,8,9 and a PPI synthase appears also to occur in chloroplasts10 and yeast mitochondria.2,11 This PPI synthase appears to be less complex than the corresponding ATP synthase, just as PPI is a simpler compound than ATP. Early electron-transport-coupled formation of energy-rich phosphate compounds may well have evolved from systems involving inorganic phosphate (Pi) and PPI to systems involving Pi, ADP and ATP,12,13 i.e. a PPI synthase may be the original membrane-bound unit for coupling between biological electron transport and phosphorylation.13

Kuranova et al.14 found that soluble inorganic pyrophosphatase from yeast has an Asp-119 residue situated close to bound metal near the reactive phosphate of enzyme-bound PPI. Recently, Fry et al.15 described a similarly situated Asp-119 residue in adenylate kinase, where the free carboxylate group of the Asp may be coordi-

§To whom correspondence should be addressed.

Table 1. Similarities between amino acid sequences in soluble PPase from yeast and some nucleotide binding polypeptides.

<table>
<thead>
<tr>
<th>113</th>
<th>119</th>
</tr>
</thead>
<tbody>
<tr>
<td>G – D – N – N – P – I – D</td>
<td>Yeast soluble PPase*</td>
</tr>
<tr>
<td>T – L – G – A – P – I – D</td>
<td>E. coli α-ATPase*</td>
</tr>
<tr>
<td>V – L – G – E – P – V – D</td>
<td>E. coli β-ATPase*</td>
</tr>
<tr>
<td>113</td>
<td>119</td>
</tr>
<tr>
<td>T – L – L – L – Y – V – D</td>
<td>Rabbit muscle adenylate kinase*</td>
</tr>
</tbody>
</table>

*Ref. 17. Ref. 18. Ref. 15.

an open question. Nevertheless, when taken together, the similarities between pyrophosphate-binding and nucleotide-binding polypeptides would appear to support a concept of "molecular co-evolution" for phosphate compounds and polypeptides. This concept is somewhat analogous to that of Williams,18 who has recently discussed the symbiosis of metal and protein functions.

Acknowledgement. This work was supported by the Swedish Natural Science Research Council.

References


Received September 26, 1986.