**Role of light in the survival of Dinoroseobacter shibae, an aerobic anoxygenic phototroph, during starvation**

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**Introduction**

Dinoroseobacter shibae DFL124T was isolated from a marine Dinoflagellate. It belongs to the aerobic anoxygenic phototrophic (AAP) bacteria which are capable of using light as a source of energy under oxic conditions without the generation of oxygen. Light was shown to induce ATP formation and proton translocation by the cells (1). However, the cells do not grow by light energy alone.

The major aim of this study is to understand under which conditions does light have the maximum competitive advantages for D. shibae. Batch cultures of D. shibae were maintained for 6 weeks under starvation in a) the dark, b) under continuous illumination and c) under dark-light cycles, and the physiological fitness was recorded (Figs. 1 and 2).

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**Results**

**Light-driven chemiosmotic processes contribute a major part to the energy metabolism of D. shibae**

Table 1: The influence of light (average light intensity 1500 µE m⁻² s⁻¹) on endogenous respiration rates and succinate-dependent respiration rates in washed cells of D. shibae (OD₅₇₀ = 2)

<table>
<thead>
<tr>
<th>Weeks starved</th>
<th>Endogenous respiration rates [nmol O₂ min⁻¹ (mg DW)⁻¹]</th>
<th>Respiration rate with succinate [nmol O₂ min⁻¹ (mg DW)⁻¹]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dark</td>
<td>Light</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>10</td>
</tr>
</tbody>
</table>

• Light significantly decreased endogenous and succinate-dependent respiration rates in pigmented cells of D. shibae during starvation.

• Endogenous respiration rates declined by 16% to 43% while succinate-dependent respiration rates declined by 24% to 43%.

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**Cellular energy charge (ATP) to the different incubation conditions**

![Cellular energy charge](image)

Fig. 4: Adenylate energy charge in cell suspensions of D. shibae

• The luciferin/luciferase [ATP bioluminescence Assay Kit CLS II, Boehringer Mannheim] method was used for the quantification of ATP.

• During starvation the adenylate energy charge (ATP) tends to decrease, but seems to be higher in the light than in the dark.

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**Morphology of the cells during long term starvation**

![Morphology](image)

Fig. 5: Transmission electron microscopic images of fresh (a and b) and cells starved for six weeks (c and d)

• Exponentially growing cells (a and b) seems to be active whereas six weeks starved cells looks like they are not fit.

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**Conclusions**

Initial starvation results suggest that

→ Even after six weeks light can be utilized and replace part of endogenous or added substrates.

→ In starved cells light contributes a bigger part to proton translocation compared to respiration.

→ The adenylate energy charge increases in the presence of light.

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