In aerobic organisms, Reactive Oxygen Species (ROS) are produced as by-products of oxygen metabolism which cause oxidative damage to DNA, proteins, and carbohydrates. The accumulation of ROS may lead to the loss of mitochondrial function and decreased cellular energy, eventually contributing to the accelerated aging of an organism. The enzyme Superoxide Dismutase (SOD) detoxifies ROS species and is an essential enzyme for the viability of aerobic organisms. Previous studies have shown that deletion of SOD in aerobic organisms, including Drosophila melanogaster, Escherichia coli, and Mus muscular, resulted in significantly shortened lifespan, reduced growth rate, and/or normal fertility. However, knockdown of the five reported SOD genes in Caenorhabditis elegans, a free-living soil nematode, posed no viability problem for the worm. In this study, an in-gel SOD activity assay was performed to compare levels of active SOD proteins in D. melanogaster, E. coli, and C. elegans. As expected, the gel-assay revealed three active SOD bands for E. coli and two active bands for Drosophila. However, the assay only yielded one active SOD band for C. elegans, confirming previous findings which reported active proteins for all five SOD genes of the organism. Previous studies have also reported an increase in SOD expression during the stress-induced dauer larval stage of the nematode as well as in the long-lived Daf-2 mutant. Thus, additional in-gel assays were performed to compare SOD protein activity in the Adult, Dauer-Larvae, and Daf-2 stages. Results continued to display single active SOD bands for all three stages, confirming that only one of the five SOD genes in C. elegans expressed active SOD protein. Minute amount of SOD protein activity in the nematode suggests that C. elegans may use an alternative free-radical system for its metabolic purposes differing from that of D. melanogaster and E. coli.

**Background**

Superoxide Dismutase (SOD) enzyme neutralizes reactive oxygen species (ROS)
- ROS are by-products of oxygen metabolism.
- Damaging to DNA, proteins, and carbohydrates.
- Loss of mitochondrial function, decreased cellular energy, contribute to aging.

**Caenorhabditis elegans**
- Soil-dwelling round worm (nematode)
- Feed primarily on bacteria
- Hermaphroditic
- 4 larval stages to adult in 2 days
- Mean life span 18 days
- Maximum life span 30 days

**SOD-gene**

<table>
<thead>
<tr>
<th>SOD-gene</th>
<th>Expression</th>
<th>Total SOD activity [μU/μg]</th>
<th>Effect on lifespan [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sod-1</td>
<td>Cytoplasmic Cu/Zn-SOD (major)</td>
<td>76%</td>
<td>No effect</td>
</tr>
<tr>
<td>Sod-2</td>
<td>Mitochondrial Mn-Sod (major)</td>
<td>18%</td>
<td>No effect</td>
</tr>
<tr>
<td>Sod-3</td>
<td>Mitochondrial Mn-Sod (minor)</td>
<td>1%</td>
<td>No effect</td>
</tr>
<tr>
<td>Sod-4</td>
<td>Extracellular</td>
<td>5%</td>
<td>No effect</td>
</tr>
<tr>
<td>Sod-5</td>
<td>Cytoplasmic Cu/Zn-SOD (minor)</td>
<td>0.5%</td>
<td>No effect</td>
</tr>
</tbody>
</table>

**C. elegans stages**

<table>
<thead>
<tr>
<th>C. elegans stages</th>
<th>Function</th>
<th>Effect on Resistance to oxidative stress</th>
<th>Effect on Lifespan [1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daf-2 Larvae</td>
<td>Increased Paraquat, Hynepoxia</td>
<td>Increased (33%-224%)</td>
<td></td>
</tr>
<tr>
<td>Dauer Larvae</td>
<td>Increased Resistant to variety of stresses</td>
<td>Able to survive several months</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

- SOD activity assay revealed three active SOD for E. coli and two active SODs for Drosophila, as reported in previous studies.
- Only one active SOD band for C. elegans is visible in the gel assay. But molecular analysis suggested five SOD genes are present in C. elegans [2].
- The single active SOD band of C. elegans aligns with the Mn-SOD band of E. coli and D. melanogaster. Contradicting previous studies report SOD-1, the major Cu/Zn-SOD, to contain 76% of total SOD mRNA in the worm.
- Knockdown of each SOD gene in C. elegans, does not pose a viability problem for the worm in contrast to other organisms [1].
- Hence, C. elegans may utilize an alternate system for free radical metabolism.

**Future Directions**

- Perform additional activity gel-assay to compare SOD Activity in C. elegans developmental stages including: L1, L4, Young Adult, and Adult stage.
- Future projects should focus on determining the specific pathway that C. elegans use to detoxify reactive oxygen species.

**References**


**Acknowledgements**

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