The Effect of UVC Radiation on Tardigrades

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Tardigrade Species

- Aquatic animals
- Require film of water around their body
- 100-500 micrometers
- Commonly found on moss, freshwater, and other damp places
- Variation in species dependent on environment
Hypsibius exemplaris
- Freshwater tardigrade
- In most cases, species does not show strong evidence of high survivability in extreme conditions

Ramazzottius varieornatus
- Terrestrial tardigrade
- Species exhibits extraordinary capacity to withstand extreme conditions such as ionizing radiation and UVC radiation
Mechanism of Resistance to Radiation

Hydrated State

- Special protein phrA suggested as mechanism for DNA repair in *R. varieornatus*
- *H. exemplaris* does not show evidence of phrA protein
- Mechanism of UVC and radiation resistance in *H. exemplaris* largely unknown

Dehydrated State

- Metabolism halted, water content decreased, and cellular content is encased in special protein
- State referred to as tun state
- Tolerance of UVC radiation in terrestrial tardigrades is higher in a desiccated state
- Both *R. varieornatus* and *H. exemplaris* can enter into a dehydrated state

Journal of Insect Physiology
Hypsibius exemplaris
freshwater tardigrade used in project

- Does not show such evidence of high survivability in most extreme conditions, such as high doses of UVC radiation.
- Exhibit high tolerance to gamma radiation
- Capacity to withstand high doses of gamma radiation in a hydrated state suggests mechanisms of tolerance besides desiccation.
- Variation in the resistance to UVC and gamma radiation suggest differences in genetic makeup of freshwater and terrestrial tardigrades
Can *H. exemplaris* withstand low doses of UVC radiation?

In this project, we studied the effect of UVC radiation on the freshwater tardigrade, *H. exemplaris*.

The presence of tardigrades after exposure to varying doses of UVC radiation was used to measure tardigrade resistance to UVC.

We hypothesized that freshwater tardigrades would have a lower survival rate after exposure to higher dose of UVC radiation.

This would show a negative correlation between tardigrade survivability and UVC radiation.

Thus, as the dose of UVC radiation increases, the proportion of tardigrade survival decreases.
Materials and Methods

- Three jars of *H. exemplaris* and one jar *Chlorococcum sp.* obtained from Carolina Biological Supply Company
- Tardigrades were transferred to 24 well-cell culture plates with a culture area of 2 sq. cm a well volume of 3.5 mL
- 18 cell plates were used to transfer tardigrades.
- Dose groups were created by grouping plates, which together summed roughly 50-60 tardigrades
- Each well contained 2 mL of a 1.5% bacto-agar gel
- Tardigrades were kept hydrated with spring water via pipette
- Culture plates were maintained in room temperature conditions with constant light exposure
Materials and Methods

- Exposed to UVC radiation via G15T8 Base Germicidal UV Light Bulb
- Each dose group was placed in the enclosure with the light off
- The light was switched on and remained on for the calculated time depending on the dose group.
- After the allotted time passed, light was turned off and each dose group remained in the enclosure for two minutes
<table>
<thead>
<tr>
<th>Dose</th>
<th>Number of Wells</th>
<th>Average Tardigrades Per Well</th>
<th>Standard Deviation</th>
<th>Time spent in UVC enclosure with light on</th>
<th>Total time in UVC Enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 kJ/m²</td>
<td>6</td>
<td>9.67</td>
<td>12.32</td>
<td>0s</td>
<td>120s</td>
</tr>
<tr>
<td>0.5 kJ/m²</td>
<td>24</td>
<td>2.62</td>
<td>2.69</td>
<td>23s</td>
<td>120s</td>
</tr>
<tr>
<td>1.0 kJ/m²</td>
<td>27</td>
<td>2.33</td>
<td>1.75</td>
<td>42s</td>
<td>120s</td>
</tr>
<tr>
<td>1.5 kJ/m²</td>
<td>12</td>
<td>5.75</td>
<td>5.83</td>
<td>63s</td>
<td>120s</td>
</tr>
<tr>
<td>2.0 kJ/m²</td>
<td>24</td>
<td>2.46</td>
<td>2.43</td>
<td>84s</td>
<td>120s</td>
</tr>
<tr>
<td>2.5 kJ/m²</td>
<td>26</td>
<td>2.31</td>
<td>2.12</td>
<td>105s</td>
<td>120s</td>
</tr>
</tbody>
</table>

**Table 1**

A summary of the pretreatment setup
Results

Figure 1

Day 3 Tardigrade Proportion Survival

Figure 1 shows the proportion of tardigrade survival on Day 3 post UVC exposure. The average tardigrade per well was used to calculate this proportion.
Results

Figure 2

Tardigrade Survival

Figure 2 follows the tardigrade survival post UVC exposure. Each data point is the average number of tardigrades per well.
Results

Figure 3

**Proportion of Tardigrade Survival by Individual Well**

Figure 3 summarizes survivability on Day 3 Post UVC Exposure.
### Table 2

**Tardigrade Survival on Day 3 Post UVC Exposure**

<table>
<thead>
<tr>
<th>Dose kJ/m²</th>
<th>Population Remaining</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>0.5</td>
<td>8.0%</td>
</tr>
<tr>
<td>1</td>
<td>14.2%</td>
</tr>
<tr>
<td>1.5</td>
<td>34.8%</td>
</tr>
<tr>
<td>2</td>
<td>0.0%</td>
</tr>
<tr>
<td>2.5</td>
<td>1.7%</td>
</tr>
</tbody>
</table>
Results

Tardigrade survival and dose found to be weakly correlated, \( r(3) = .34, p = .032 \).

Survivability of tardigrades exposed to the highest dose of UVC radiation at 2.5 kJ/m\(^2\) was 1.7%.
Analysis

- Control group of 0.0 kJ/m² showed a 0% survival rate
- Possible indication of unknown factors contributing to the tardigrade's low survival rate
- Variation in survival among dose groups suggests results may be inconclusive
Acknowledgements

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Gąsiorek, P.; Stec, D.; Morek, W.; Michalczyk, Ł. AU - Michalczyk, Łukasz An integrative redescription of Hypsibius dujardini (Doyère, 1840), the nominal taxon for Hypsibioidea (Tardigrada: Eutardigrada) Zootaxa (2018) 4415, 45-75


