Analysis of radiation from radon on bioactive compounds present on Nasturtium officinale leaves

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This is a very preliminary work!

- In this work the effect of the ionizing radiation in the bioactive compounds present in the leaves of the Nasturtium officinale (watercress) was analyzed through its exposure in atmosphere containing different concentrations of radon.
Why Watercress?

Because...

... This vegetable grows abundantly on the riverside;

...The watercress is a vegetable highly consumed in salads;

Rio Diz, in Guarda
Why Watercress?

Because...

... Epidemiological studies have shown multiple biological effects related to the phenolic compounds found in watercress extracts, namely:

- Antimicrobial
- Anticancer
- Antioxidant activities
- Anti-inflammatory

... The watercress extracts can act in vitro to combat the growth and metastasis of cancer cells.
**Experimental procedure:**

- A granitic rock of uraniferous origin was placed inside the closed box.

- A vessel was filled with water and was put in the previous box, together with a heating plate, recreating a thermal atmosphere \((T = 40 \, ^\circ\text{C} \text{ e HR} = 100 \%)\).

- Radon concentration in the air was monitored with RAD7 equipment from the American company Durridge.
All the samples were placed for the same time, only varying the radon concentration in the air.

- The plants of watercress were separated in 4 identical, properly identified, water containing containers.

- Each sample was placed for 45 minutes inside the box.

All the samples were placed for the same time, only varying the radon concentration in the air.

**Results**

The table shows the value of the radon concentration in the atmosphere, inside the box, for the different samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Radon concentration (Bq/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>156 ± 5</td>
</tr>
<tr>
<td>1</td>
<td>3180 ± 770</td>
</tr>
<tr>
<td>2</td>
<td>3570 ± 220</td>
</tr>
<tr>
<td>3</td>
<td>5160 ± 230</td>
</tr>
</tbody>
</table>
The use of **Scanning Electron Microscope** allows a qualitative evaluation of the microstructure in the fresh leaves of watercress.

- A large number of chloroplasts were observed, responsible for photosynthesis.
- No changes were observed in plant tissues in the different samples.

 Parenchyma and Chloroplast Cells
Determination of bioactive compounds: phenols, flavonoids and antioxidant activity

- The Soxhlet extraction process was applied to the dry mass samples.

- The Folin-Ciocalteu method was used for the determination of the total phenols.

- The flavonoids were determined by a colorimetric method with aluminum chloride.

- The determination of the antioxidant activity in the watercress extract was performed by the DPPH (2,2-difenil1picrilhidrazil) method in which the DPPH free radical sequestering activity was evaluated.
Results obtained in determining the total content of phenols and flavonoids

<table>
<thead>
<tr>
<th>Sample</th>
<th>Radon concentration (Bq/m³)</th>
<th>Ethanolic extract in methanol (g/ml)</th>
<th>Total Phenols (mg EAG/g of dry matter) $M^- \pm \delta$</th>
<th>Total Flavonoids (mg EQ/g of dry matter) $M^- \pm \delta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>156 ± 5</td>
<td>0,011</td>
<td>30,93 ± 5,20</td>
<td>6,06 ± 0,95</td>
</tr>
<tr>
<td>1</td>
<td>3180 ± 770</td>
<td>0,0098</td>
<td>40,19 ± 3,21</td>
<td>6,75 ± 0,23</td>
</tr>
<tr>
<td>2</td>
<td>3570 ± 220</td>
<td>0,0111</td>
<td>49,76 ± 2,15</td>
<td>7,51 ± 0,09</td>
</tr>
<tr>
<td>3</td>
<td>5160 ± 230</td>
<td>0,0125</td>
<td>63,21 ± 0,48</td>
<td>8,66 ± 0,07</td>
</tr>
</tbody>
</table>

The content of phenols and flavonoids increases with increasing radon concentration.
Determination of the antioxidant activity of the ethanolic extracts in the watercress leaves

<table>
<thead>
<tr>
<th>Sample</th>
<th>IC$_{50}$ (mg/L) $\bar{M} \pm \delta$</th>
<th>AAI $\bar{M} \pm \delta$</th>
<th>antioxidant activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>255,97 ± 20,75</td>
<td>0,238 ± 0,007</td>
<td>very poor</td>
</tr>
<tr>
<td>1</td>
<td>187,10 ± 1,24</td>
<td>0,281 ± 0,002</td>
<td>very poor</td>
</tr>
<tr>
<td>2</td>
<td>160,58 ± 0,07</td>
<td>0,323 ± 0,031</td>
<td>very poor</td>
</tr>
<tr>
<td>3</td>
<td>149,69 ± 3,96</td>
<td>0,314 ± 0,007</td>
<td>very poor</td>
</tr>
</tbody>
</table>

The antioxidant concentration required to sequester 50% of the DPPH moiety under assay conditions (IC 50) shows a downward trend with the increasing radon concentration.

The antioxidant activity index - AAI shows an increasing tendency in the samples 0, 1 and 2 but decreasing in sample 3.
Conclusions

Samples that were submitted to an atmosphere containing high radon concentration showed changes in the bioactive compounds.

This type of behavior can be attributed to the possible stress conditions to which the plant was subjected, leading to activate / continue the main biosynthetic pathways of these secondary metabolites.
Next work

- Study the bioactive compounds present in the leaves of Watercress, when subjected to aquatic environments, with different concentrations of radon.

- Verify by liquid scintillation spectrometry whether there is bioaccumulation of radioactive substances descending from the radioactive chain of radon.
Obrigada