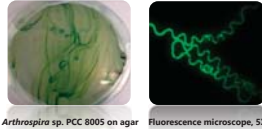
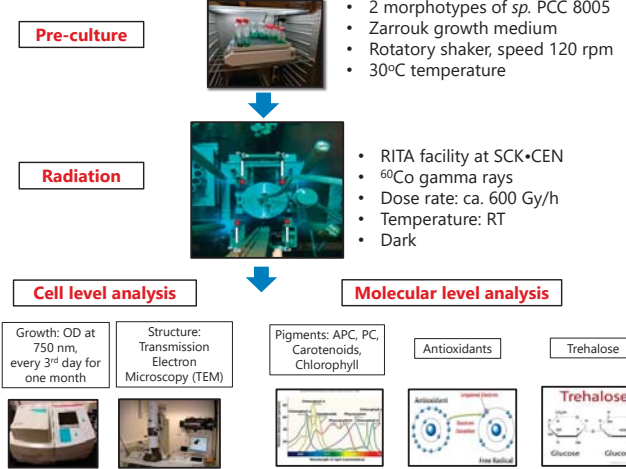


Introduction

- Arthrospira* are filamentous, multicellular cyanobacteria that typically reside in alkaline lakes. They are blue-green in colour with cylindrical cells organised in helicoidal trichomes.
- As photosynthetic organisms, *Arthrospira* are able to convert solar energy into chemical energy by oxidising water while they produce O₂ and fix CO₂. They have a high protein content and are rich in minerals, vitamins, carbohydrates, and essential fatty acids and hence *Arthrospira* are globally used for their added-value products or as feed- and food stock.
- Original PCC 8005 is curly in morphology (P6) but a new mutant straight morphotype of PCC 8005 was found in lab (P2), having interesting properties.
- Arthrospira* was found to be highly resistant to gamma radiation (Badri et al. 2015).



Materials and methods



Objective

The immediate aim of this study is to elucidate the radiation resistance mechanisms of *Arthrospira sp.* PCC 8005, on the cellular and molecular level.

Results

A. Growth

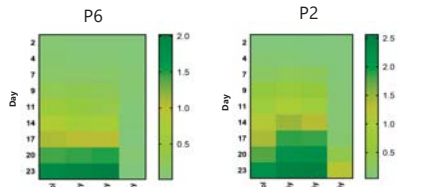


Fig 1: Morphotypes exposed to different doses of ⁶⁰Co radiation (C- curly (P6) and S- Straight (P2) morphology) showed a significant difference in radiation sensitivity.

B. TEM

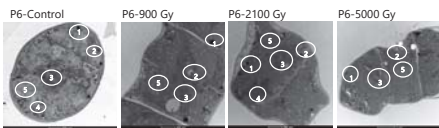


Fig 2: TEM images (by courtesy of K. Waleron, Medical University of Gdansk): 1: Polyphosphate granule, 2: Lipid inclusion, 3: Carboxysomes, 4: Glycogen granule, 5: Thylakoid

C. Trehalose

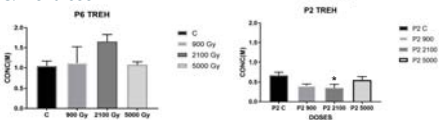


Fig 3: Trehalose concentration (a) in strain P6 and P2 at different IR doses. Significant difference between control and 2100 Gy in strain P2.

D. Total antioxidant proteins

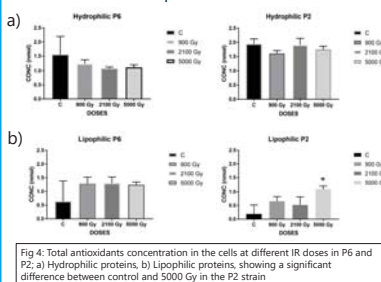


Fig 4: Total antioxidants concentration in the cells at different IR doses in P6 and P2: a) Hydrophilic proteins, b) Lipophilic proteins, showing a significant difference between control and 5000 Gy in the P2 strain.

E. Glutathione

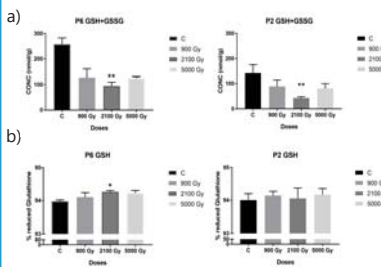


Fig 5: Glutathione concentration in cells at different IR doses in P6 and P2: a) Total glutathione concentration, showing significant difference between control and 2100 Gy in both morphotypes, b) % of reduced glutathione out of total glutathione, showing a significant difference between control and 2100 Gy in the P6 strain.

F. Pigments

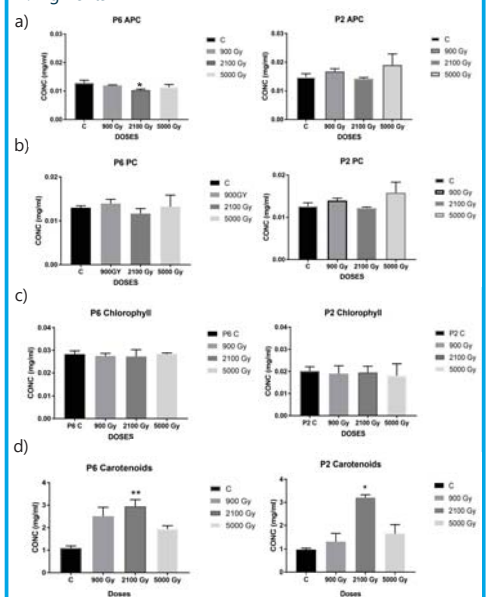


Fig 6: Pigment concentration in cells at different IR doses in P6-P2 strain : a) Allophycocyanin (APC) concentration, showing a significant difference between control and 2100 Gy in the P6 strain (less IR resistant), b) Phycocyanin (PC) concentration, c) Chlorophyll concentration, d) Total carotenoids concentration, showing significant difference between control and 2100 Gy in both morphotypes

Discussions

- We observed a difference in IR resistance between the two morphotypes of *Arthrospira sp.* PCC 8005 i.e. P2 (straight trichomes) and P6 (spiral trichomes), the former being more resistant (Fig. 1).
- The original morphotype (P6) didn't display any structural damage (Fig. 2), not even after 5000 Gy which did have a growth impact.
- The trehalose concentration in morphotype P2 (straight; more IR resistant) decreases significantly at 2100 Gy as compared to non-irradiated control (Fig. 3).
- The amount of lipophilic proteins (e.g. vitamin E, carotenoids, chlorophyll) increases significantly at 5000 Gy in morphotype P2 (straight; more IR resistant) (Fig. 4 (b)).
- The total glutathione concentration decreases significantly in both morphotypes as a result of radiation (Fig. 5(a)), out of which the percentage of reduced glutathione is significantly increasing in P6 (curly; less IR resistant) at 2100 Gy (Fig. 5(b)).
- The amount of allophycocyanin pigment decreases significantly at 2100 Gy in P6 (curly; less IR resistant) (Fig. 6(a)). Also, the total carotenoid content is significantly increasing in both morphotypes at 2100 Gy (Fig. 6(b)), while the concentration of other pigments remain unchanged.

Conclusions

- Being more resistant to IR, the P2 cells display a lower trehalose content which further decreases at 2100 Gy, suggesting an improved metabolic use of trehalose and possible rerouting of cellular energy.
- The consistently higher cellular content of hydrophilic and lipophilic proteins in P2 (more IR resistant) at high IR doses up to 5000 Gy suggest a role in protection against IR by antioxidants. This is also suggested by sudden increase in carotenoids and more usage of glutathione at 2100 Gy.
- The amount of APC is higher in P2 than in P6, (significantly higher at 5000 Gy) suggesting a more light-harvesting capacity in P2 but the negligible difference in other pigments implies that the photosynthetic capacity is not (or only in a very limited way) affected by ionizing radiation.