Is the Mehler reaction the main photoprotective mechanism occurring in *Symbiodinium in hospite* ?

S. Roberty [1] *, E. Béraud [1], P. Cardol [2] & C. Ferrier-Pagès [1]

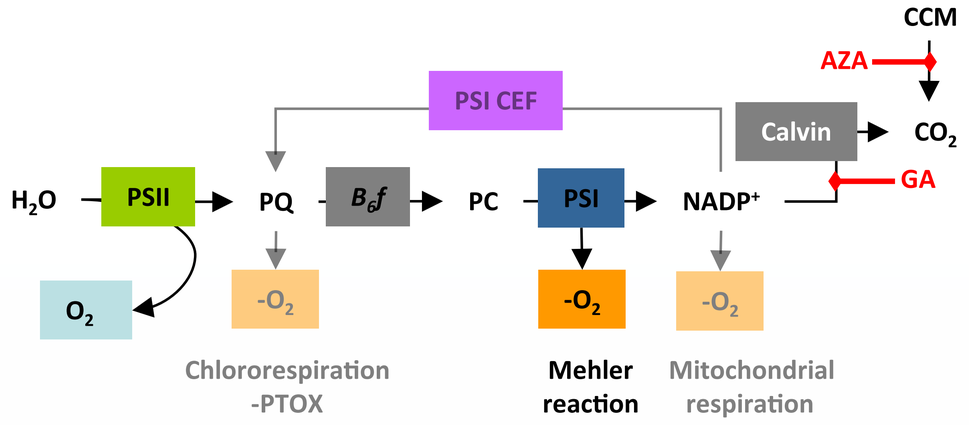
[1] Centre Scientifique de Monaco, Marine Department, Monaco
[2] Genetic & Physiology of Microalgae, University of Liège, Belgium

* Corresponding authors | E-mail: sroberty@centrescientifique.mc

Introduction

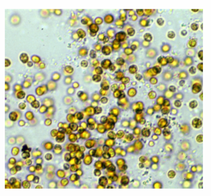
In the natural environment reef-building corals have to cope with significant daily variations in light intensities that sometimes exceed the photosynthetic capacity of their endosymbiotic dinoflagellates (*Symbiodinium* sp.). Fortunately, these organisms possess various photoprotective and regulatory mechanisms to cope with changing and high light intensities. Among them, it has been found recently that photoreduction of O_2 downstream PSI by the Mehler reaction was the main alternative electron sink at the onset and steady state of photosynthesis in different cultured strains of *Symbiodinium*.

In this study, we investigated the occurrence and the relative amplitude of this photoprotective mechanism in *Symbiodinium* cells living within the tropical coral *Stylophora pistillata*.



Scheme of the photosynthetic electron transfer chain: main players and alternative pathways

S. pistillata at CSM

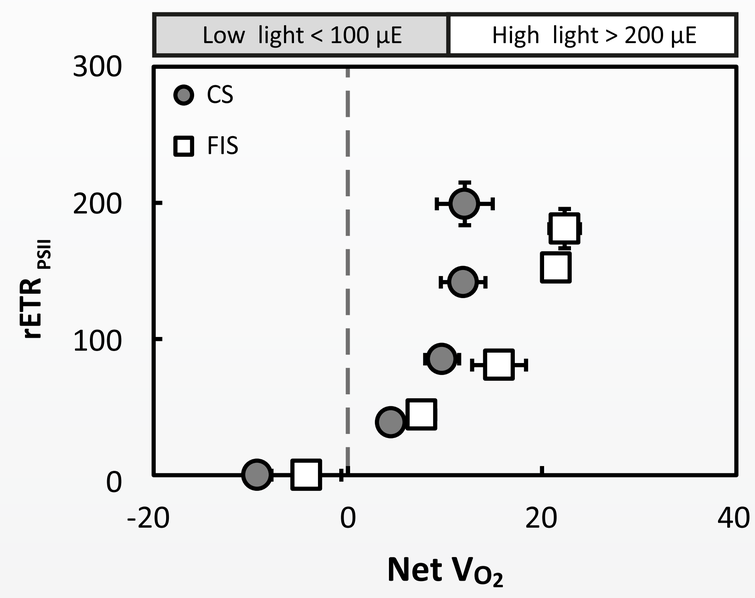


Symbiodinium from *S. pistillata*

1

Isolated Symbiodinium

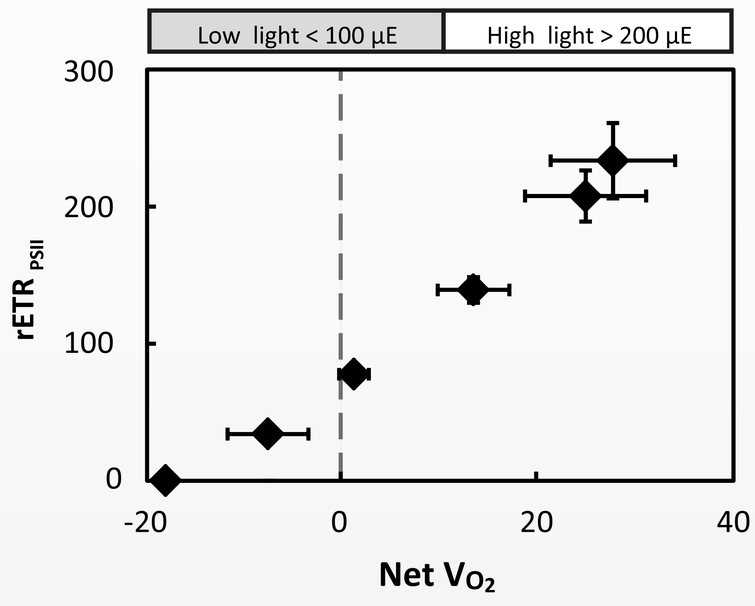
Discrepancy between oxygen evolution and PSII electron transfer rate confirms that O_2 uptake (= Mehler reaction *sensu* Roberty *et al* 2014) occurs in high light in cultured (CS) and freshly isolated *Symbiodinium* (FIS) from *S. pistillata*.



2

In symbiosis

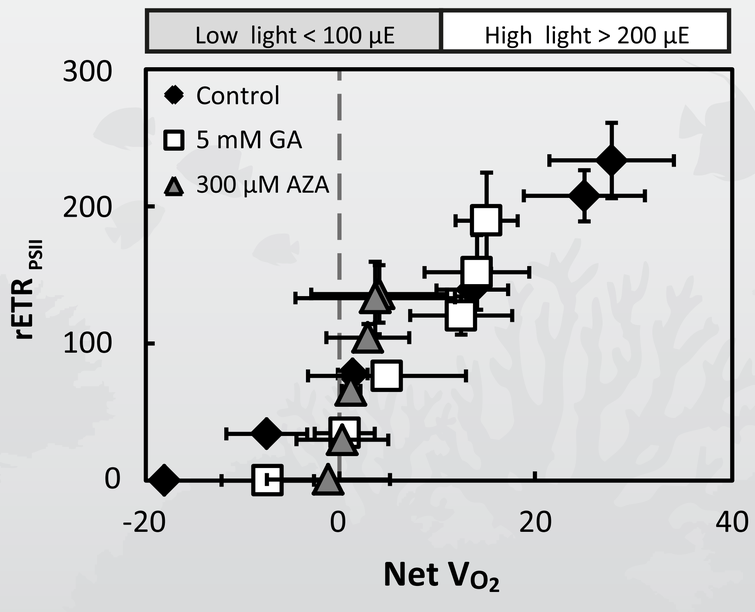
Linear relationship between O_2 evolution and PSII electron transfer rate indicates that O_2 uptake may not occurs under high light in *Symbiodinium* in symbiosis with *S. pistillata*.



3

With inhibitors

When *S. pistillata* is in presence of Calvin cycle (GA) and CCM (AZA) inhibitors, we observe an O_2 uptake under the ligh similar to the pattern observed on isolated *Symbiodinium.*



Conclusions

Joint measurements of oxygen evolution and PSII activities indicate that the reduction of O_2 at the acceptor side of PSI is not the primary electron sink at steady state of photosynthesis in *Symbiodinium* within *S. pistillata*.

However, a significant photosynthetic electron flow is directed to the Mehler reaction when the mechanisms of CO_2 entry/fixation are compromised under high light.

Under such conditions, this mechanism prevents photoinhibition thus acting as a photoprotection mechanism, it promotes ΔpH formation and thus modifies the ratio of ATP/NADPH to match cellular energetic needs.

$rETR_{PSII}$ in µmol e m^{-2} s^{-1} | Net V_{O_2} in pmol O_2 s^{-1} µg^{-1} chl-*a* | Max light intensity: 650 µmol photon m^{-2} s^{-1}.