The Tropical Sea Anemone *Aiptasia pallida* as a Lab Model for the Study of Coral Bleaching

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Introduction

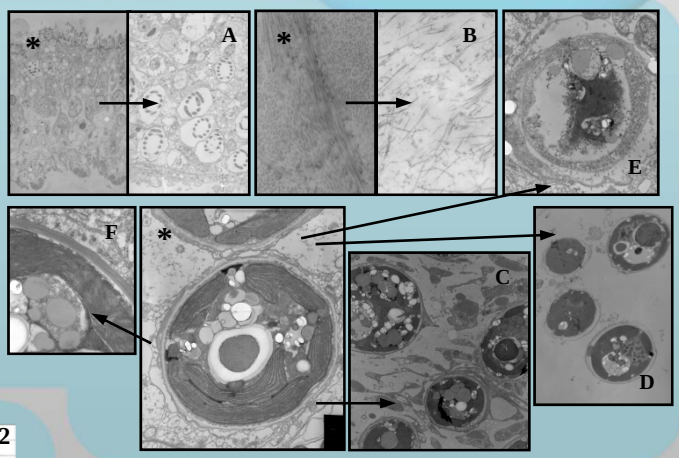
Bleaching is still among major events threatening coral reefs. New tools have to be developped to better understand the mechanisms leading to this pathology : we studied the use of the **zooxanthellate anemone *Aiptasia pallida*** as experimental model for coral bleaching. Aiptasia appears as a good candidate as it is easy to maintain in aquarium and subjected to bleaching like corals.

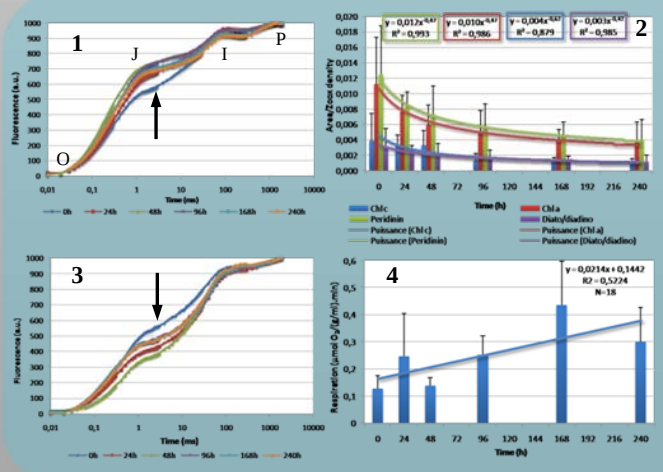
Purpose and experimental procedure

Stresses of **intense light** (450-600 µmol photons/m²s) and **darkness** (0-1 µmol photons/m²s, without thermal stress, due to high ventilation of the light source) were applied on 50 *A. pallida* anemones, for each stress condition. Control and stressed anemones were compared through **morphological and physiological approaches**. Firstly, TEM and light microscopy were used to investigate changes in the **ultrastructure** of the anemone tissues and their symbiotic algae. Secondly, **chlorophyll *a* fluorescence** (fluorimeter), **respiration** (oxymeter) and **pigmentation** (HPLC) were measured to understand the photophysiology of the zooxanthellae inside their host anemone.

Results and discussion

Morphology. Experiments under light and dark stress reveal that anemone tissues ultrastructure can be differently affected. In **darkness**, the ectoderm activity is reoriented to capture prey by **increasing cnidocyte density** (A). In contrast, **intense light** affects especially the **gastroderm** and its **endosymbionts**: intercellular spaces increase (C), intact algae are released in the gastric cavity (D) and zooxanthellae altered inside gastrodermal host vacuoles (E) seem to reduce the zooxanthellae density. Chloroplast thylakoids lose regular arrangement (F), that suggests an altered photosynthetic system. The **mesoglea** is also damaged and appears disorganized (B). * are control healthy anemones.





Photophysiology. The analysis of the **fluorescence induction curve** (OJIP; graph 1 & 3) appears as a powerful tool to discribe the physiological events series previous to bleaching. The **decrease of pigments concentrations** indicates that light or dark stresses induce anemone bleaching (graph 2). Under **strong light intensity**, *A. pallida* zooxanthellae show an **increased proportion of PSII QB non reducing** (quinone B in the photosystem II, no more able to reduce the quinone A in the electron transport system) due to the fast saturation of the electron transport system thus leading to partial photoinhibition. This phenomenon favours the **ROS production** (Reactive Oxygen Species), through the interaction of excited chlorophylls with oxygen, damaging cellular structures of host and zooxanthellae. As there is **no photosynthesis** in **darkness**; anemones have therefore to find other feeding sources, as suggested by the ultrastructural approach (cnidocytes production), implying a **higher level of respiratory activity** (graph 4).

Conclusions

Morphological alterations were observed in all tissues of the anemones, in host cells as well as in algal cells. Moreover, physiological disruptions confirm morphological damages like thylakoids disorganization (due to ROS production under intense light stress?). In darkness, anemones have to find other feeding sources. In that way, cnidocytes production was increasing respiration. As the present results confirm some of those obtained on scleractinians, with similar responses to stress, *A. pallida* can be considered as a good model for laboratory coral bleaching studies and , moreover, as it has numerous advantages for experimentation (size, no calcification, easy to maintain in closed circuit tanks).

O. Ladrière is PhD student of the National Fund for Scientific Research in Belgium (F.N.R.S - Fonds National de la Recherche Scientifique).