Physiology and role of endolithic community in the massive coral Porites lutea

メタデータ	言語: en
	出版者: Shizuoka University
	公開日: 2018-06-08
	キーワード (Ja):
	キーワード (En):
	作成者: Sangsawang, Laddawan
	メールアドレス:
	所属:
URL	https://doi.org/10.14945/00025250

（課程博士・様式７）（Doctoral qualification by coursework,Form 7）

学 位 論 文 要 旨

Abstract of Doctoral Thesis

専　　攻：　環境エネルギーシステム　　　　　　氏　名：ラダワン　サンサワン
Course：Environment and Energy Systems　Name：Laddawan Sangsawang

論文題目：塊状ハマサンゴ中の骨格に生存する微細藻類の生理的状態と役割
Title of Thesis：Physiology and role of endolithic community in the massive coral *Porites lutea*

論文要旨：
Abstract：

Corals evolved to adapt to oligotrophic environments by establishing symbiotic relationships with a variety of microbes forming the so called "coral holobiont". In Addition to the symbiotic algae zooxanthellae, other associated organisms play crucial roles in environmental adaptation of the coral holobiont by providing organic and inorganic carbon and organic nitrogen, and protecting the coral host from pathogen. Among associated microbes, the endolithic community is one of the less studied entities within the coral holobiont. Members of this community appear in remarkably high numbers in massive and encrusting corals, particularly corals from the family Merulinidae and Poritidae. Translocation of organic matter from endoliths to the coral host was firstly mentioned by Fine and Loya (2002), however, they did not evaluate this process in terms of the organic matter synthetized and transferred. In this research I wished to determine how much the endolithic community fixes organic carbon and whether they are capable to fixing atmospheric nitrogen and translocating it to the coral host. Moreover, I wanted to investigate how the endolithic community can provide photo-protection to the coral host. I focused my study in the massive coral *Porites lutea*, since it is a common coral in Okinawa reef and appear to be very resistant to environmental stressors as high temperature and strong illumination.

Firstly, I studied the chemical-biological interactions between the coral holobiont and surrounding seawater environment in healthy and bleached corals. Results showed significant changes in water quality along the incubations of bleached corals: particularly nutrients and dissolved organic carbon (DOC) were released from bleached corals with parallel increase in bacterial abundance and decreased in dissolved oxygen (DO). This condition can promote coral disease and disturbances in the reef community. Following, I dedicated to the study the endolithic community composition and their pigments, photosynthetic performance (*Fv/Fm*) and physiological parameters as primary production, nitrogen fixation in endolithic community as well as in the coral tissues. I also tried to quantify how much organic matter can be translocated from endoliths to the coral tissues. Microscopic studies revealed the presence of the Chlorophyta *Ostreobium quekettii*, the cyanobacterium *Leptolyngbya terebrans* together with two fungal forms. For physiological studies, I exercised incubation experiments of *Porites lutea* with addition of ^{13}C and ^{15}N tracers to measure primary production and nitrogen fixation in coral tissues (Addition experiment) and direct injection of ^{13}C inside endolithic green band (Injection experiment) to evaluate translocation rates. The *Fv/Fm* of endoliths after the incubations showed similar values in healthy and bleached corals, indicating comparable photosynthetic performances in both conditions. Primary production of endolithic community was higher in bleached corals (3.4 µg C cm^{-2} day^{-1}) than in healthy corals (2.2 µg C cm^{-2} day^{-1}). In coral tissues there was an increase in primary production over the 24h incubation in spite of the respiration during the dark period from 8.7 µg C cm^{-2} day^{-1} in 12h light to 23 µg C cm^{-2} day^{-1} in 24h, revealing some external source of organic matter that could be related to translocation from endoliths. Nitrogen fixation was detected in both coral tissues and the endolithic community and translocation of nitrogen rich organic compounds was revealed by the study of C/N ratio along incubations. The study of ^{13}C atom (%) incorporation in coral tissues during the Injection incubation revealed an important translocation pattern with 2 to 8% translocation from endoliths (higher in healthy corals). This means that endolithic community can support coral nutrition in normal as well as stressful conditions during bleaching.

To explore the responses of coral host and endolithic community to oxidative stress, H_2O_2 scavenging activity was measured in healthy and bleached *P. lutea*. Coral nubbins were incubated under two temperatures (27 °C as normal temperature or 34 °C), two illuminations (360 as normal and 680 µmol photons m^{-2} s^{-1}), and the combination of them during 6h. *Fv/Fm* of healthy coral tissue decreased from initial after exposure to light and high (34 °C) temperature stresses. However, the *Fv/Fm* in bleached coral tissue increased along or remained the same in all treatments. Endolithic algae showed the same pattern in both coral conditions with a decrease in *Fv/Fm* under high irradiance and the combined treatment. Corals showed a significant increase in H_2O_2 scavenging activity during light and thermal stresses, however scavenging activity was low under combined stresses. On the other hand, endolithic algae showed increase in scavenging activity at all treatments. These results show the capacity of rapid response of endolithic algae to environmental stresses, however in coral tissues, the stress levels in combined treatment overpassed the coral capacity to fight against oxidative stress. The main conclusion is that the endolithic community plays a crucial role in supporting the coral holobiont. The rapid recovery of photosynthesis and pigments in endolithic algae illustrates their plasticity to acclimate to drastic environmental changes.