The Effects of Sugar Enrichment on Coral

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What is a Coral?

Coral is a colonial animal related to hydroids, jellyfish, and sea anemones. A coral colony contains hundreds to thousands of individual polyps with mouths, tentacles, and nematocysts with the ability to capture and consume prey. Corals also have symbiotic relationships with endolithic algae, where the algae provide corals with important nutrients to survive while being protected by the coral's skeleton and flesh.

Environmental stressors that threaten this symbiosis include

- Ocean warming
- Ocean acidification
- Pollution and debris
- Hurricanes
- Etc.

Corals are also host to microbial organisms such as diazotrophs, that are nitrogen fixing bacteria. Evidence suggests that diazotrophs might help corals recover from after bleaching and encourage symbiotic algae growth. Sugar enrichment has been shown to stimulate growth of diazotrophs and nitrogen fixation in corals. In this study, we used increasing sugar concentrations to study the growth and symbiotic state of *Oculina arbuscula*.

Oculina arbuscula

Oculina arbuscula is a facultatively symbiotic coral that is found off of the coast of North Carolina. Facultatively symbiotic means that this species of coral is able to survive both with and without the symbiotic algae.

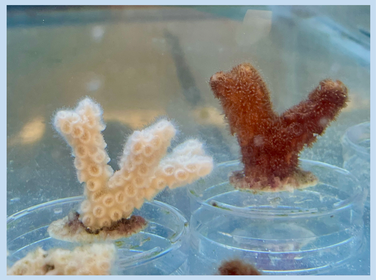


Fig 1. Aposymbiotic (left) and symbiotic (right) colonies of *Oculina arbuscula*, a facultatively symbiotic coral found in North Carolina.

Research Questions

What is the effect of sugar enrichment on the growth and symbiotic state of symbiotic and aposymbiotic colonies of *Oculina arbucsula*?

How does sugar enrichment impact the health of the coral host and the diazotrophs?

Methods

Experimental Design

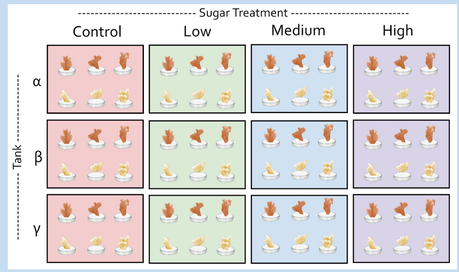
We tested temperature, nitrate, salinity, and pH daily to make sure these factors remained constant throughout the experiment. Corals were fed artemia 2 days each week. There were a total of 12 tanks with 6 corals in them. Each tank was exposed to one of four different levels of sugar enrichment:

Control (0ppm),

Low (5ppm),

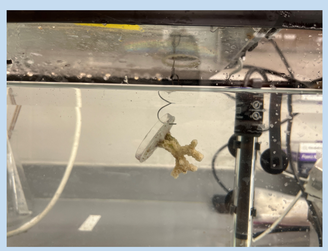
Medium (10ppm),

High (20ppm).



This experiment was run for 2 weeks, with data at T0 (day 0) and T1 (day 14).

Buoyant Weight



To measure buoyant weight, each coral was glued to a clear plastic plate with a unique identifier and a hole in them. Each plate was hung from a scale in a saline tank to measure the weight of the corals in water to assess their growth over time.

Photo Analysis

Photos of the coral nubbins were taken at T0 and T1 on a color identification card. Matlab was used to quantify the color intensity of each coral. To do this, 15 dots were chosen at random to collect data on the color levels in each photo. These color intensity values were then averaged and compared across the treatments.

Funding for this research was provided by PADI grant # 5124674 to Anastasia Dulskiy. Aichelman, H. E. *et al. Ecol. Evol.* **6**, 6758–6769 (2016). Bednarz, V. N. *et al. Environ. Microbiol.* **21**, 480–495 (2019). Hutchins, D. A. & Capone, D. G. *Nat. Rev. Microbiol.* 1–14 (2022) doi:10.1038/s41579-022-00687-z. Jokiel, P. 529–541 (1978). Pogoreutz, C. *et al. Glob. Change Biol.* **23**, 3838–3848 (2017). Rädecker, N. *et al. ISME J.* **16**, 1110–1118 (2022). Winters, G., Holzman, R., Blekhman, A., Beer, S. & Loya, Y. *J. Exp. Mar. Biol. Ecol.* **380**, 25–35 (2009).

Results

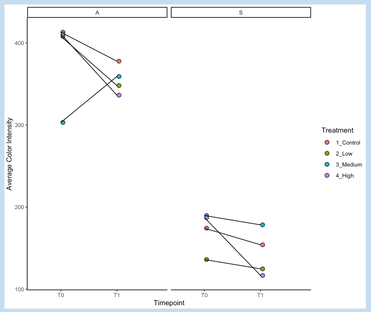


Figure 2. Average color intensity of aposymbiotic and symbiotic *Oculina arbuscula*. With the exception of aposymbiotic corals from the medium treatment, all corals became more symbiotic over the course of the experiment.

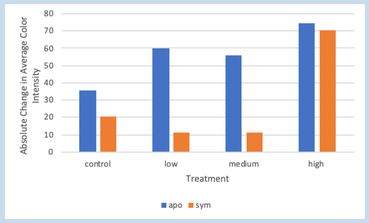


Figure 3. Absolute change in color intensity of both aposymbiotic and symbiotic corals. The aposymbiotic corals have much higher absolute increase in color intensity overall.

Conclusion

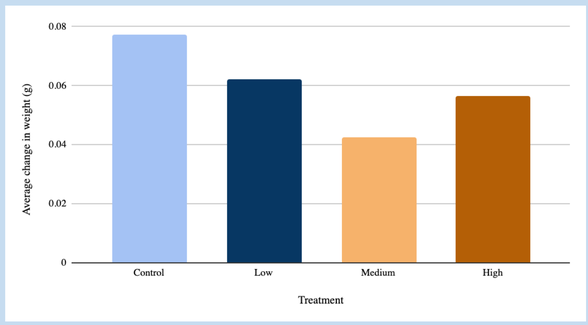


Figure 4. Average change in buoyant weight over two weeks. The control is significantly higher than the rest of the treatments. The high treatments are not significantly different from the medium and low treatment. The medium treatment is significantly lower than the low treatment.

Sugar enrichment treatments appear to decrease overall coral growth, but increases algal symbiosis. In contrast to this, we see that corals in the medium sugar treatment are becoming more aposymbiotic than those of other treatments, but this may be due to the fact that they are initially very symbiotic. These findings support Claudia Pogoreuz's model of the coral symbiosis breakdown due to over enriched diazotrophs. In the future, longer sugar treatment experiments should be conducted with a variety of different coral species to better understand the coral algae bacteria symbiosis.