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# A Coral's Genetic Response to Stress

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When it gets hot, our skin gets flushed, we sweat, or we get burns. At the same time, our cells are actively producing all kinds of molecules to help deal with any damage that may be caused by high temperature. In the oceans, corals experiencing warmer seawater temperatures may exhibit coral bleaching, or whitening, as symbiotic microalgae, which help provide the corals with nutrients, are ejected. This phenomenon may lead to the eventual death of corals and the coral reef communities that they support.

As temperatures continue to rise around the world, scientists are now trying to gain a better understanding of what will happen to corals when they are exposed to warmer oceans. Researchers Andrian Gajigan and Cecilia Conaco from the Marine Science Institute of the University of the Philippines Diliman, are examining this topic on a molecular level.

In a study published in Molecular Ecology, they try to find out if molecules called microRNAs, or miRNAs, which play an important role in our own cells, may also be involved in the coral response to stress.

RNAs are single-stranded counterparts of DNA that typically function as messengers, carrying the genetic code written in DNA to another part of the cell, where the code is used to create a protein. As their name implies, microRNAs are strands of RNA that are much shorter than usual. However, instead of functioning as messengers, microRNAs function as regulators. They interact with other RNA strands, and prevent the production of the protein that they encode. When the miRNA falls off or is removed from the RNA strand, then protein production can resume. Much like the dial on a radio that controls the volume of sound, miRNAs can control the amount of protein that is produced from a specific RNA.

To look into the role that miRNAs play in the stress response of corals, the researchers exposed samples of the coral, *Acropora digitifera*, to hot water to induce a stress response, and extracted miRNA from their cells. To see the effects that the hot water had, they also extracted miRNA from corals that were exposed to cooler water, at temperatures within the coral's usual range.

An *Acropora digitifera* colony from Bolinao, Pangasinan

The researchers identified a total of 26 different miRNAs, most of which have never been seen before. Interestingly, they found that one of the miRNAs, called Adi-Mir-Novel 5_3p, was more abundant in corals growing in normal seawater but not in corals that were exposed to hot water.

This particular miRNA appeared to regulate a variety of RNAs encoding stress response proteins that are required for cellular first aid and damage repair, as well as for making more permanent changes in the coral, in case conditions do not improve.

With this at the center of their findings, the researchers propose a model for how the coral stress response is regulated by the miRNA. According to their model, the coral keeps a stock of messenger RNAs—that code for the proteins that are needed to deal with stress—in its cells.

Under normal circumstances, the miRNA is abundant and interferes with these RNAs. This means that the stress-related protein that these RNAs would code for will not be produced. However, when the coral senses an increase in seawater temperature, the amount of the miRNA drops drastically. This then frees up its target RNAs and, because the messenger RNAs are already present in the cell, it allows the production of much-needed stress response proteins to begin right away.

This mechanism is appealing because it may provide the coral with a way to react rapidly to stress in a manner that is also reversible, should conditions improve. A stress response mechanism regulated by miRNAs is also advantageous because one miRNA can regulate many different biochemical pathways. So by inducing a change in just one molecule, a wide variety of changes can be induced in the entire organism.

Further studies in other corals will need to be done to establish the role of miRNAs in the coral stress response. While viability of this model still needs to be tested, it is still an important access point for other researchers to study this relatively unexplored area. This work opens up new avenues of research aimed towards understanding the genetic responses of corals to stress. It could also have implications for the role that miRNAs play in other aspects of coral physiology, aside from stress response. This is crucial for efforts to discover ways to protect and conserve coral reefs worldwide.

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