New research reveals corals could be trained to survive environmental stress

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Aposymbiotic *Aiptasia* (sea anemone genus). Credit: Guoxin Cui and Antonio Ruiz

Scientists have discovered the first molecular evidence that corals and anemones can optimize their gene expression when exposed to environmental stress, enabling them to acclimatize to extreme conditions such as those experienced during climate change.

"In a nutshell, we could train toughened corals in nurseries to improve their thermal resilience, helping them to better cope with rising sea temperatures before out planting them in the reefs," Says Dr. Manuel Aranda, lead author and assistant professor of marine science in the Red Sea Research Center at King Abdullah's University of Science and Technology (KAUST).

"Genetic adaptation is a slow process, because it requires beneficial mutations to spread through the population, which takes quite some time in organisms like corals with long generation times. Our findings are important because epigenetic mechanisms present a potentially fast way to increase the survivability of corals in light of the current speed at which climate change progresses," Dr. Aranda says.

This research could have a huge impact on the conservation of economically valuable reef formations upon which countless marine organisms rely for habitat. By studying how tiny sea anemones use epigenetic mechanisms to regulate the expression of genes involved in their symbiosis with photosynthetic algae, the researchers have found these mechanisms may help corals and anemones acclimatize to environmental stress, and believe this could be harnessed to improve their resilience to the challenges posed by climate change.

The team based in KAUST's Biological and Environmental Sciences & Engineering Division sequenced anemone genomes using a technique that detects DNA methylation—a chemical tag attached to DNA affecting gene expression without altering the genetic sequence. They found that nearly 40 percent of anemone genes were methylated, and that the methylation level of a gene correlated with its expression level. Their findings are published in the journal *Science Advances*.

By comparing sequences from anemones with and without symbiotic algae, the team identified roughly 2,000 genes that had different methylation patterns in response to symbiosis, many of which were involved in the establishment, maintenance, and breakdown of symbiosis, including genes involved in recognition, engulfment of symbionts, and nutrient exchange.

"The next step is to look at DNA methylation changes involved in acclimation to temperature stress and to check if these changes are passed on to the offspring. If this is the case, we could use the process of environmental hardening to "train" the parents and produce pre-acclimated larvae that could be used to seed reefs," Dr. Aranda says.

The team plans to investigate how DNA methylation changes in response to temperature stress and whether these epigenetic changes are inherited. They also plan to design long-term experiments to determine how long the acclimation lasts.

More information: "DNA methylation regulates transcriptional homeostasis of algal endosymbiosis in the coral model Aiptasia" *Science Advances* (2018). advances.sciencemag.org/content/4/8/eaat2142

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