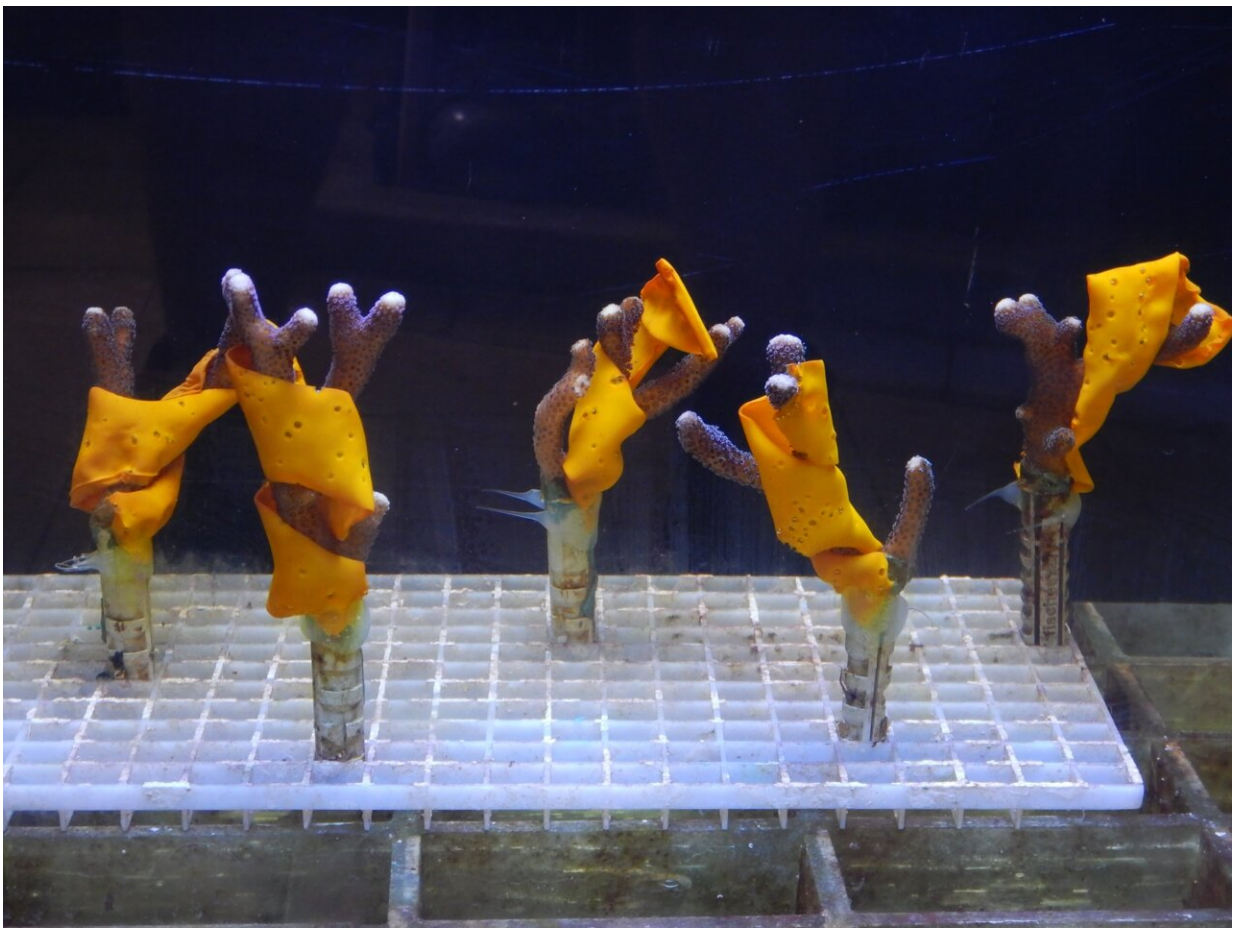
Researchers demonstrate efficacy of curcumin in protecting coral from damage caused by climate change

July 19 2023



Stylophora pistillata coral covered with biomaterial during thermal stress tests. Credit: IIT/Università Milano-Bicocca

Researchers at Italian Institute of Technology—IIT and University of Milan-Bicocca, in cooperation with Genoa Aquarium in Italy, have recently published a study in *ACS Applied Materials and Interfaces*, which demonstrates the efficacy of curcumin, a natural antioxidant substance extracted from turmeric, in reducing coral bleaching, a phenomenon caused primarily by climate change.

The research group developed a biodegradable biomaterial to deliver the molecule without causing damage to the surrounding marine environment. Tests conducted at the Genoa Aquarium have shown significant efficacy in preventing coral bleaching.

Coral bleaching is a phenomenon that, in extreme events, causes the death of these organisms with devastating consequences for coral reefs, which are crucial for the global economy, the protection of coastlines from natural disasters, and marine biodiversity. Most corals live in symbiosis with microscopic algae, which are indispensable for their survival and are responsible for their vibrant colors.

Due to climate change, sea and ocean temperatures are rising, a condition that disrupts the relationship between these two organisms. When this happens, the coral, which turns white due to the loss of algae, literally risks starvation.

In recent years, as a result of climate change, this condition has affected most of the world's major coral barrier reefs, including Australia's Great Barrier Reef. However, to date there are no effective methods of countering this phenomenon and preventing coral bleaching without seriously endangering the survival of these habitats and the exceptional biodiversity associated with them.

Stylophora pistillata coral covered with biomaterial during thermal stress tests. Credit: IIT/Università Milano-Bicocca

Curcumin is administered to the coral in a controlled manner by applying a biomaterial based on zein, a protein derived from maize, a system developed by the partners themselves in order to ensure safety for the environment.

During the tests, performed at the Genoa Aquarium, overheating conditions in tropical seas were simulated by raising the water temperature up to 33°C. Under these conditions, all untreated corals were affected by the bleaching phenomenon as would occur in nature, while, on the contrary, all specimens treated with curcumin showed no signs of this tendency, a result that makes this technique effective in reducing the susceptibility of corals to thermal stress.

A coral species (Stylophora pistillata) typical of the tropical Indian Ocean, included in the IUCN (International Union for the Conservation of Nature) Red List of endangered species, was used for this study.

"This technology is the subject of a patent application that has been filed, and in fact the next steps of this research will focus on its application in nature and on a large scale," said Marco Contardi, first author of the study, research affiliate of the Smart Materials group at IIT and researcher in DISAT (Department of Environmental and Earth Sciences) at the University of Milan-Bicocca. "At the same time, we will examine the use of other antioxidant substances of natural origin to block the bleaching process and thus prevent the destruction of coral reefs."

"The use of new biodegradable and biocompatible materials capable of releasing natural substances that can reduce coral bleaching is something entirely new," said Simone Montano, researcher at DISAT and deputy director of the MaRHE center (Marine Research and High Education Center) at the University of Milan-Bicocca. "I strongly believe that this innovative approach will represent a significant breakthrough in the

development of strategies for the recovery of marine ecosystems."

More information: Marco Contardi et al, Biodegradable Zein-Based Biocomposite Films for Underwater Delivery of Curcumin Reduce Thermal Stress Effects in Corals, *ACS Applied Materials & Interfaces* (2023). DOI: 10.1021/acsami.3c01166

Provided by Italian Institute of Technology