# Study examines the impact of coral chemical compounds on reef composition and health

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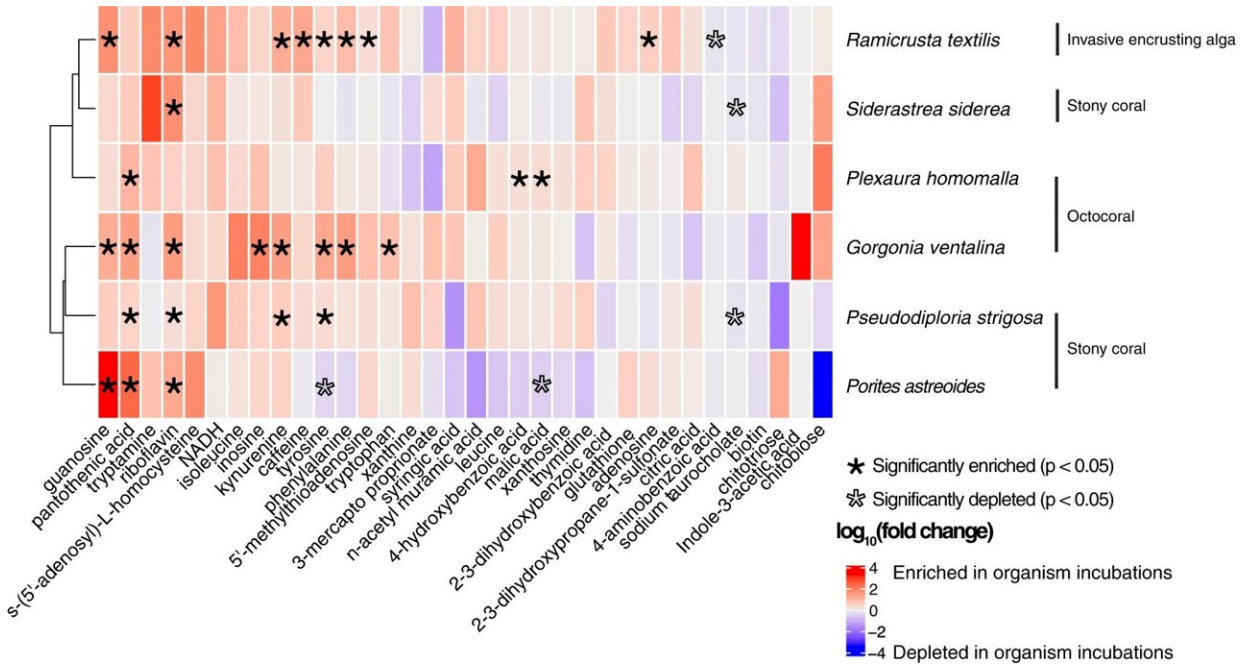


Heatmap of average $\log_{10}$(fold changes) between organism and control incubations demonstrates that specific targeted metabolites are significantly enriched and depleted and vary by species. Colors correspond to $\log_{10}$(fold change) and asterisks reflect significantly enriched (black) or depleted (outlined) metabolites in organism compared to control incubations as determined using Welch's t-tests. Credit: *ISME Communications* (2022). DOI: 10.1038/s43705-022-00184-7

Stumbling upon a new source of underwater caffeine was just an added

bonus of a new study examining the impact of chemical compounds that corals release into the seawater.

The study found that the organic chemical compounds produced through metabolism—known as metabolites or exudates—vary significantly by coral species and that the compounds impact the abundances and compositions of reef microorganisms differently.

This differential release of metabolites from benthic reef organisms is particularly significant in the Caribbean where coral dominance is shifting from hard stony corals to soft octocorals in response to human-caused stressors such as eutrophication, overfishing, and global climate change.

The study "demonstrates the importance of benthic exudates for structuring microbial communities on oligotrophic reefs by focusing on the exudates released from abundant stony corals, octocorals, and an invasive alga," according to the paper led by authors from the Woods Hole Oceanographic Institution (WHOI), "Benthic exometabolites and their ecological significance on threatened Caribbean coral reefs," published in *ISME Communications.*

"We wanted to know what are the molecules that coral organisms release into the environment, and how do those molecules impact the reef microbes in the seawater surrounding the corals," said lead author Laura Weber, a former postdoc and current information systems associate in WHOI's Marine Chemistry & Geochemistry Department.

"As the species composition of these reefs shifts, it is likely changing the chemicals that are released on the reef that then will have impacts on the microbial community," Weber said. "We need to pay more attention to how changes in reef structure and species composition might influence the microbes that live on the reef, leading to more feedbacks in terms of

reef health." She said that understanding microbes on reefs, how they are functioning, and how they might be contributing to the health of corals and of reefs themselves is "pretty much an untapped area to explore."

Here's the caffeine connection.

For the study, researchers collected exudates from six species of Caribbean benthic organisms in a lab setting, using organisms obtained from within the Virgin Islands National Park, including stony corals, octocorals, and an invasive encrusting alga called Ramicrusta textilis. The researchers surprisingly found that R. textilis released caffeine in high quantities.

Their results further "demonstrate that exudates from benthic organisms contribute to the complex pool of extracellular metabolites in reef seawater and that exudate composition varies significantly by species," according to the study

As to why R. textilis produces caffeine, the study notes that caffeine production has not been widely investigated for marine organisms, but that it is a common metabolite produced by land plants generally to deter herbivores and pathogenic microbes. These characteristics "could contribute to the ability of R. textilis to invade and flourish on Caribbean reefs," according to the report. "Given the growing prevalence of Ramicrusta on diverse Caribbean reefs, follow-up research examining the ecological significance of its metabolites on microbes and other reef organisms is needed."

This study "is an important step forward in identifying chemical signals that can help scientists assess reef health," said Elizabeth Kujawinski, co-author of the paper. "Similar to human health diagnostics, the chemical signals within a reef ecosystem are intimately linked to the functions of the symbiotic relationships within reefs." Kujawinski is a senior scientist

in WHOI's Marine Chemistry & Geochemistry Department and director of the Center for Chemical Currencies of a Microbial Planet (C-CoMP), a National Science Foundation Science and Technology Center that is based at WHOI.

Co-author Amy Apprill, associate scientist in WHOI's Marine Chemistry & Geochemistry Department, said an important implication of the research is that a diverse benthic community helps to contribute to a more varied metabolite pool and likely supports a more diverse microbial community.

"We are trying to build kind of a library of what microbes and metabolites are present on reefs. My dream is to be able to go out to a reef, take a bucket of reef water, screen it for microbes and metabolites, and be able to tell something about the health of that ecosystem," Apprill said. "This is so important to do because the current methods to monitor reefs are highly visual-based, and it can take months or years to determine if coral is sick or growing. Metabolites and microbes have the potential to be really sensitive sensors for reef health."

**More information:** Laura Weber et al, Benthic exometabolites and their ecological significance on threatened Caribbean coral reefs, *ISME Communications* (2022). DOI: 10.1038/s43705-022-00184-7

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