



## Morphology, phylogeny, and toxicity of three *Gambierdiscus* species from the South China Sea, including a coral-killing bloom of *G. carpenteri* in reef tanks

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### ABSTRACT

*Gambierdiscus* is a genus of benthic dinoflagellate commonly found in coral reef ecosystems. Some species produce neurotoxins, such as ciguatoxins (CTXs) and maitotoxins (MTXs), which have been linked to ciguatera poisoning (CP), an illness prevalent in tropical regions. In this study, three *Gambierdiscus* species, *G. caribaeus*, *G. carpenteri*, and *G. vietnamensis* were identified from coral reefs of the South China Sea based on detailed morphological and phylogenetic analyses. This is the first report of *G. carpenteri* along the Chinese coast, and a bloom of *G. carpenteri* in coral culture tank that caused coral mortality was documented. While no known CTXs and MTXs were detected in the newly isolated *Gambierdiscus* strains, 44-methylgambierone was present in all three species; further, *G. carpenteri* strains produced protonated adducts of Gambieric acids A and C. The results of MTT in vitro assay showed that *G. vietnamensis* exhibited the highest cytotoxicity to both cancerous and noncancerous cell lines, while *G. caribaeus* demonstrated moderate inhibition of noncancerous cells and colon adenocarcinoma, with lower toxicity against other colon cancer cell lines. In contrast, the bloom samples of *G. carpenteri* showed low cytotoxicity across all tested cell lines, suggesting that *G. carpenteri* may affect coral health through mechanisms beyond cytotoxicity. Higher nitrogen levels relative to phosphorus likely promoted the initiation of *G. carpenteri* blooms and sustained the high density in the culture tanks. The shading effect by the massive *G. carpenteri* mats likely limited the light intensity required by the corals, while elevated  $\text{NH}_4^+\text{-N}$  concentrations during the bloom period may further contribute to coral mortality. These findings underscore the effects of *Gambierdiscus* species influencing coral health, highlighting the need for further investigation into the mechanisms underlying the impacts on the reef ecosystems.

### 1. Introduction

Ciguatera poisoning (CP) is a widespread illness caused by the consumption of reef fish contaminated with potent neurotoxins including ciguatoxins (CTXs) and maitotoxins (MTXs) (Chinain et al., 2021;

Litaker et al., 2017). These toxins are produced by benthic dinoflagellates in the genera *Gambierdiscus* Adachi & Fukuyo and *Fukuyoa* F. Gómez, D. Qiu, R.M. Lopes & S. Lin, which typically proliferate on macroalgae and detritus on dead corals (Chinain et al., 2020; Leung et al., 2018). CP is particularly prevalent in tropical and subtropical

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