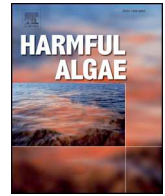




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## Growth and epiphytic behavior of three *Gambierdiscus* species (Dinophyceae) associated with various macroalgal substrates

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## ABSTRACT

Species of the benthic dinoflagellate *Gambierdiscus* produce polyether neurotoxins that caused ciguatera fish/shellfish poisoning in human. The toxins enter marine food webs by foraging of herbivores on the biotic substrates like macroalgae that host the toxic dinoflagellates. Interaction of *Gambierdiscus* and their macroalgal substrate hosts is believed to shape the tendency of substrate preferences and habitat specialization. This was supported by studies that manifested epiphytic preferences and behaviors in *Gambierdiscus* species toward different macroalgal hosts. To further examine the supposition, a laboratory-based experimental study was conducted to examine the growth, epiphytic behaviors and host preferences of three *Gambierdiscus* species towards four macroalgal hosts over a culture period of 40 days. The dinoflagellates *Gambierdiscus balechii*, *G. caribaeus*, and a new ribotype, herein designated as *Gambierdiscus* type 7 were initially identified based on the thecal morphology and molecular characterization. Our results showed that *Gambierdiscus* species tested in this study exhibited higher growth rates in the presence of macroalgal hosts. Growth responses and attachment behaviors, however, differed among different species and strains of *Gambierdiscus* over different macroalgal substrate hosts. Cells of *Gambierdiscus* mostly attached to substrate hosts at the beginning of the experiments but detached at the later time. Localized *Gambierdiscus*-host interactions, as demonstrated in this study, could help to better inform efforts of sampling and monitoring of this benthic toxic dinoflagellate.

### 1. Introduction

Species of the benthic dinoflagellate *Gambierdiscus* Adachi & Fukuyo (Adachi and Fukuyo, 1979) are known to produce the polyether neurotoxins, Gambiertoxins and Ciguatoxins (Litaker et al., 2017). The toxins are transferred via food chains, transformed and bioaccumulated in higher trophic levels, and cause Ciguatera Fish/shellfish Poisoning (CFP) in human (Berdalet et al., 2012, 2017; Chinain et al., 2016; Roué et al., 2016; Darius et al., 2018a, b). Gastrointestinal, cardiovascular and neurological disorders are among the symptoms of CFP (Lehane and Lewis, 2000; Friedman et al., 2007, 2008). Other benthic harmful dinoflagellates are implicated in this human illness (Tindall and Morton, 1998) but without supporting evidence. Outbreaks were usually reported from the central Pacific Ocean, the Indian Ocean and Caribbean Sea (Lewis, 2001; Skinner et al., 2008; Berdalet et al., 2017). Increasing incidence of CFP in the Asia Pacific region has also been

reported and claimed to be associated with the increasing trade and demand for wild live reef fishes (Chan, 2015; Lee et al., 2019).

The dinoflagellates *Gambierdiscus* species are distributed globally in the tropic and subtropical regions. They are common components in the epiphytic microbial assemblages of coral reefs, which associated with biotic substrates like macroalgae and turf algae (Yasumoto et al., 1979; Cruz-Rivera and Villareal, 2006; reference herein) as an obligate epiphyte (grew on the surface of substrates) or metaphyte (forming a mucilaginous matrix that attached to the substratum). Recent ecological studies that employed a field sampling technique utilizing artificial substrate (Tan et al., 2013; Tester et al., 2014) has also demonstrated that *Gambierdiscus*, despite inhabits microhabitats with biotic substrates, was found distributed in a variety of microhabitats associated with high percent coverages of hard corals and microhabitats without (or with very low) macroalgal covers (Yong et al., 2018), suggesting spatial heterogeneity and habitat complexity of these

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