Salinity effect on growth and toxin production of four tropical *Alexandrium* species (Dinophyceae)

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Abstract

Four tropical PSP toxins-producing dinoflagellates, *Alexandrium minutum*, *Alexandrium tamiyavanichii*, *Alexandrium tamarensense* and *Alexandrium peruvianum* from Malaysian waters were studied to investigate the influences of salinity on growth and toxin production. Experiments were conducted on constant temperature 25 °C, 140 $\mu\text{E mol m}^{-2} \text{s}^{-1}$ and under 14:10 light:dark photo-cycle with salinity ranged from 2 to 30 psu. The PSP-toxin congeners, GTX 1–6, STX, dcSTX, NEO and C1–C2 were analysed by high performance liquid chromatography. Salinity tolerance of the four species in decreasing order is *A. minutum* > *A. peruvianum* > *A. tamarensense* > *A. tamiyavanichii*. Specific growth rates and maximum densities varied among these species with *A. minutum* recorded as the highest, 0.5 day⁻¹ and 6×10^4 cells mL⁻¹. Toxin content decreased with elevated salinities in *A. minutum*, the highest toxin content was about 12 fmole cell⁻¹ at 5 psu. In *A. tamiyavanichii*, toxin content peaked at optimal growth salinity (20 and 25 psu). Toxin content of *A. tamarensense*, somehow peaked at sub-optimal growth salinity (15 and 30 psu). Results of this study implied that salinity fluctuation not only influenced the growth physiology but also toxin production of these species.

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1. Introduction

Dinoflagellates from the genus *Alexandrium* have been well known as producers for the potent neurotoxins that cause paralytic shellfish poisoning (PSP) in many coastal countries throughout the world (Anderson et al., 1994; Halegraef et al., 1995). Blooms of *Alexandrium* and

outbreak of poisoning cases have caused serious economic losses in the fishery industries of the affected countries. Public health concern arose with increasing poisoning cases due to the consumption of contaminated bivalves. This has been particularly pronounced in countries where seafood is the main source of protein. Malaysia is not an exception from this menace. Before 1990s, *Pyrodinium bahamense* is the only PSP causative organism in Malaysian waters with blooms and PSP outbreaks confined to Sabah. The perception changed with the increased in number of toxic *Alexandrium* species found as well as the PSP cases reported in Peninsula Malaysia (Usup et al., 2002; Lim et al., 2002). Five species of *Alexandrium* have been identified. Out of these species, *Alexandrium tamiyavanichii* and *Alexandrium minutum* were reported as toxic (Usup et al., 2002). Two additional *Alexandrium* species, namely *Alexandrium taylori* and *Alexandrium peruvianum* were later found in

Abbreviations: psu, practical salinity unit; PSP toxins, paralytic shellfish poisoning toxins; GTXs, gonyautoxins; STXs, saxitoxins; dcSTX, decarbomoyl-saxitoxin; NEO, neosaxitoxin; C toxins, N-sulfo-carbamoyl-toxins.

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