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The role of nutrient-related genes in understanding the saxitoxin production of *Alexandrium minutum*

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Abstract: *Alexandrium minutum* is a saxitoxins-producring marine dinoflagellate that responsible for paralytic shellfish poisoning (PSP). It is widely distributed in the tropical and temperate waters with various hydrographic regimes. The physiological responses of this species to various macronutrients have been studied intensively, but little is known about the regulating mechanism of nutrient uptakes and their roles in saxitoxin production. The effect of varying levels of nitrogen and phosphorous nutrition on the transcriptional responses of a tropical ribotype of A. minutum was investigated in a laboratory setting. The nutrient-related genes, ammonium transporter (*AmAmt1*), nitrate transporter (*AmNrt2*), phosphate transporter (*AmPiPT1*), nitrate reductase (*AmNas*), glutamine synthetase (*AmGSIII*) and carbarmoyl phosphate synthase (*AmCPSIII*) were assembled from Sequence Read Archive (SRA) data set, and later used in the differential gene expression analyzed by qPCR. The results showed that, *AmAmt1* was suppressed in excess ammonium-grown culture; conversely *AmNrt2* and *AmNas* were induced. Gene expression of *AmAmt1*, *AmNrt2*, *AmNas*, *AmGSIII*, *AmCPSII* and *AmPiPT1* was highly induced under P-deficient condition, suggesting that the cells are scavenging to take up nutrients in the P-stress condition. Gene expression of *AmCPSII* was well correlated with the toxin cell quota, suggesting the gene might involve in arginine metabolism and simultaneously increased the toxin production. Nonetheless, *AmGSIII* expression might play a role in the stress adaption towards high toxic levels of ammonium ambient by producing toxins as a counteracting response. The results of this study have provided better insights into the eco-physiology of *A. minutum* in relation to the toxin production and its adaptive strategies in unfavorable environments.

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