Monitoring and Detection of Harmful Algal Blooms: New Approach and Tools

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Global coastal environments are increasingly affected by regular harmful algal blooms (HABs). Many of the South East Asia (SEA) coastal regions are also experiencing regular HAB outbreaks which caused massive fish kills and shellfish poisonings. In Singapore, several massive fish kill events associated with toxic dinoflagellate blooms were observed. The increase in frequencies of HABs have led to enhanced interests in monitoring and detecting of such blooms. To better protect coastal economies and human health, improved HABs monitoring and prediction are necessary. Currently, there are an array of tools ranging from autonomous vehicles, portable molecular instruments, optical sensors to remote sensing platforms that could be utilized for generating high-resolution data. Technologies and tools available for monitoring and forecasting HABs are rapidly advancing. These advanced technologies and tools are contributing to new and high-resolution data, which could be incorporated in models for predicting and forecasting bloom events. In the present study, an integrated approach involving laboratory analysis, advanced technique and tools was utilized to study and monitor HABs. We used multiscale-sensing technique which involved autonomous surface vehicle (ASV) and optical sensors to track blooms. We were able to map bloom patches of a toxic dinoflagellate and track the movements of bloom patches for five consecutive days during the 2016 northeast monsoon period. Distinct biological and environmental patterns were observed from the ASV measurements. Moreover, we have successfully used the real-time PCR (q-PCR) method to detect the toxic dinoflagellate *Karenia mikimotoi* in the field. On the other hand, data from the laboratory analysis showed that nutrient supply was relatively high during the bloom period. Our observations also revealed that diatoms co-occurred with the toxic *Karenia mikimotoi* bloom. These showed that nutrients especially the nitrogen sources could be a critical parameter determining the duration of bloom. The complexity of bloom dynamics and the interaction between different species especially multi-species bloom suggested that integrated tools and platforms are critical to enhance our studies and monitoring efforts in particularly in coastal regions with high eutrophication and disturbances. The autonomous platforms used in this study could assist in collecting highresolution data, which was not possible with point sampling. With evolving technologies and improved bio-optical equipment, detailed temporal and spatial characterizations of HABs could be feasible.

SELENATE (SeO_4) AND SELENITE (SeO_3) TOXICITY AND *DE NOVO* TRANSCRIPTOME ASSEMBLY IN *CHIRONOMUS KIIENSIS*

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Selenium is an essential micronutrient to organisms, including aquatic insects but can be very toxic at slightly above threshold levels. Research on Se contamination is very rare in South East Asia especially in Malaysia and the awareness of Se toxicity among researchers is also low compared to other regions. Recent evidence shows that selenite (SeO_3^{2-}) selenium is more toxic than selenate (SeO_4^{2-}) selenium. However, the question on 'how selenite toxicity differs from selenate' remain unsolved. Therefore, the present study was designed to investigate the toxicity of inorganic selenium in chemical forms of selenate and selenite to aquatic midges, *Chironomus kiiensis* and to gain better understanding on the genetics in response to sub-lethal exposure. We tested the toxicity and molecular responses of larvae exposed to different concentrations of Se in 96hr toxicity tests and later, we exposed the organisms for 14days in sub-lethal toxicity tests with different concentrations based on proportions of the 96hLC_{50} data; 10%, 25%, 50% and 100% of the 96hLC_{50} value obtained from acute toxicity tests. In acute tests, the 96hLC50 values of SeO_4^{2-} and SeO_3^{2-} were 16.17 ppm and 10.66 mgl^{-1}, respectively, indicating that SeO_3 is more toxic compared to SeO_4. For chronic toxicity tests, the metal accumulation for various stages of *C. kiiensis* can be summarised as follows (ranked from most to least accumulated) for selenate exposure: Exuviae > Larval > Pupa > Egg > Adult. For selenite exposure: Larvae > Exuviae > Pupa > Adult. For molecular analysis, samples of chironomid larvae were selected from the highest concentration of LC_{50} value of both metal exposure on sampling point of day 2 – a day before highest mortality was recorded. Transcriptomic expression analysis was used to elucidate the molecular mechanism of toxic-Se response using RNA-sequencing (RNA-Seq) analysis. The experiment also attempted to investigate the toxic-Se-related pathways involved between these two forms of selenium. Whole body RNA extraction was performed to obtain Se-toxicity related expression. All samples were then sequenced on the Illumina Hiseq 2000 platform, *de novo* assembled and subsequently analyzed for differential expression (DE) profiling. Functional studies were done by analyzing gene ontology and pathway enrichment. A total of 43,493,744 and 45,599,362 raw reads each for Selenate (SS) and Selenite (SST) were obtained, generating 6.52 Gb and 6.84 Gb of data, respectively. DE analysis showed that there were significant differences of expression profiles between both groups. A total of 186 transcripts were differentially expressed with 144 up-regulated and 42 down-regulated. It was found that the toxic-Se specific genes were significantly enriched in functions related to oxygen binding (globin, hemeprotein), and significantly depleted in genes related to proteolysis (silk protein, Balbiani ring). Overall, these results suggest that Se toxicity as selenate and selenite show different toxic effects to *C.kiiensis* but the difference was not significant. The findings from this study discover a lot of interesting results and further improvement is recommended by adding more bioreplicate. This will certainly increase the significance of differentially expressed gene (DEG) as well as understanding of the molecular mechanism of toxic-Se response to aquatic organisms.

Wind as a Potential Renewable Energy Source for Clean and Sustainable Future Power Generation: Malaysia Experiences.

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Renewable energy (RE) is a form of energy source that can be replaced by a natural process. It is a term used to describe the energy that is derived from sources such as the sun and wind, which are indigenous to the country, and continually available. The threats of climate change caused by combustion of coal and diesel make the extra rapid development of renewable energy sources a global imperative. Malaysia like other countries in the world is trying to find other alternatives in the generation of electricity. Among the sources of renewable energy (RE), the wind energy is the fastest growing energy technology in the world and considered as one or sources that meet the needs of modern societies in reducing the dependence on coal and diesel whilst at the same time delivering substantial reduction in greenhouse gas emission.

However, the introduction of winds as an alternative source of energy is often criticized since the power provided from the wind is intermittent and virtually uncontrollable.
In recent time, researchers in this country were studying the potential and suitability of wind energy as a new source of renewable energy that can be developed. If it found suitable, the wind energy would be scheduled in the eligible RE source in Renewable Energy Act 2011, with four other renewable energy sources.

The Malaysian government established a national energy policy plan 2012 during the tenth Malaysia Plan 2011-2015. The objective of this policy was to drive the strategic development of various new energy resources, including renewable energy (RE). It covers develop energy generated from natural resources such as solar, wind, tides and geothermal. There are high potential for using renewable energy as mentioned as the main source to generate electricity in Malaysia. The renewable energy policy has five objectives which are forward looking and embodies the elements of energy, industry and environmental policies.

Moreover, making it convergence in nature and spurring the economy forward. The renewable energy policy objectives include increasing renewable energy contribution in the national power generation mix, facilitate the growth of the renewable energy industry, ensure reasonable renewable energy generation costs, and conserve the environment for future generations as well as to enhance awareness on the role and importance of renewable energy.

This presentation reviews the progress made by wind energy in recent years and discusses the potential of this technology in the context of Malaysia particularly in wind speed conditions and make comparison with others country specially in ASEAN region.