The University of Hong Kong
School of Biological Sciences

Public Seminar

Epigenetic-associated phenotypic plasticity in the edible oyster under ocean acidification

Date: Feb 22nd, 2022 (Tue)

Time: 3:00 PM

Venue: Zoom

About the speaker:

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Abstract:

Edible oysters are known for their remarkable adaptation to harsh marine environment and nutritious delicacy. Nevertheless, unprecedented impacts associated with human-CO_2 induced ocean acidification (OA), is imposing immense threats to these shellfish resources on a global scale, especially in coastal aquaculture areas. Consequently, the pelagic benthic life cycle and productivity of the oysters are predicted to be adversely affected in current and near-future high-CO_2 coastal areas. Coastal managers, aquaculture industry and scientists are therefore, interested to know whether oysters possess environmentally-induced epigenetic mechanisms to "rapidly" adapt to OA. Epigenetics allow us to gain insights into non-genetic adaptation, transgenerational inheritance, and persistence of stress memory in marine species. More recently, epigenetic has become a hot topic in the field of OA research to improve management strategies for oyster aquafarming.

To investigate this, the ecologically and commercially important estuarine oyster species, Hong Kong oyster (*Crassostrea hongkongensis*) was used as the model to study epigenetic adaptation to OA stress in the context of mariculture. *C. hongkongensis* was first subjected to OA-induced low pH 7.4 against control pH 8.0 condition at larval stage in hatchery to identify and study the epigenetic mechanism i.e DNA methylation pattern and its molecular pathways to explain the physiological and developmental traits of the metamorphosing oyster. Several follow-up studies had the adults and/or larvae exposed to OA stress before being outplanted as post-metamorphic juveniles at three different mariculture sites with contrasting environmental stressors for over 9 months. This is to examine how DNA methylation alters gene expression to account for the trans-generational and within-generational carry-over OA effects on the phenotypic traits of the species in the mariculture environment.

C. hongkongensis larvae had exon-oriented differential methylated genes related to cytoskeleton, energy metabolism, oxidative stress, and signal transduction that help mediate the higher metamorphosis success rate under low pH 7.4, despite poor substratum selection ability. After being outplanted in the field, the growth and survival of the oysters were moderately and adversely affected, depending on the larval OA exposure history and the contrasting estuarine conditions. Similarly, the methylome and transcriptome of the species were site- and OA exposure-dependent. A multi-mode DNA methylation-associated gene expression profile demonstrated the adaptive plastic responses that had higher methylated exon:intron ratio that linked to general metabolic and endocytic pathways. In contrast, oysters were found to have significantly improved survival with prior parental OA exposure, which implies the greater influence of transgenerational than within-generational exposure in assessing the OA-induced carryover capacity of *C. hongkongensis* in the natural environment. The distinct mode of gene regulation profile and specific catalytic genes and functions that were found only in parental-exposed and not larval-exposed oysters were the crucial factors that mediate the positive carry-over developmental traits. These conclude that *C. hongkongensis* possess the capability to trigger DNA methylation via epigenetic modification as a rapid adaptive response in mediating physiological and developmental traits within- and across-generation under the influence of OA and other stressors in the natural environment.

ALL ARE WELCOME.