NUS National University of Singapore | Department of Biological Sciences, Faculty of Science

BIOLOGY COLLOQUIUM

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Hosted by A/P Antonia Monteiro





Molecular and cellular physiology of butterfly pupal wings: real-time in-vivo observations

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Butterfly wing color patterns are formed at the pupal stage. Thus, to understand how wing structures, including color patterns, are determined during development, characterization of pupal wing epithelial cells is critical. We have devised a simple method in which pupal hindwings are exposed so that cellular dynamics can be visualized in real time in vivo. Both larval and pupal epithelial cells immediately after pupation were rich in mitochondria and intracellular networks of endoplasmic reticulum, suggesting high metabolic activities, likely in preparation for cellular division, polyploidization, and differentiation. Larval epithelial cells in the wing imaginal disk were relatively large horizontally and tightly packed, whereas pupal epithelial cells were smaller and relatively loosely packed. Furthermore, larval cells were flat, whereas pupal cells were vertically elongated as deep as 130 μm. In pupal cells, many endosome-like or autophagosome-like structures were present in the cellular periphery down to approximately 10 μm in depth, and extensive epidermal feet or filopodia-like processes were observed a few micrometers deep from the cellular surface. Cells were clustered or bundled from approximately 50 μm in depth to deeper levels. From 60 μm to 80 μm in depth, horizontal connections between these clusters were observed. Organizing centers for the border symmetry system were apparent immediately after pupation, exhibiting a relatively dark optical character following treatment with fluorescent dyes, as well as in autofluorescent images. The pupal wing tissue displayed spontaneous low-frequency Ca2+ waves that propagated slowly over long distances. These results together with other findings could eventually reveal molecular and cellular mechanisms of color pattern formation in butterflies.

Artwork by Ann Nee, DBS, NUS