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One gene, two sides of butterfly's wings

NUS biologists identify gene that affects patterns on top and bottom wing surfaces

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The African squinting bush brown may not be a colourful butterfly to look at, but it has eyespots – markings which resemble the human eye – that demand attention.

Biologists from the National University of Singapore (NUS) have identified a gene that affects the appearance of eyespots found on the butterfly's wings.

The gene, called apterous A, is known to be essential for wing development in Drosophila fruit flies, but its role in creating different patterns on the top and bottom surfaces of a butterfly's wings is unclear.

"No one knows what's the molecular basis of the dorsal (top surface) and ventral (bottom surface) patterning," said Ms Anupama Prakash, the author of the study and a final-year PhD student at NUS' Department of Biological Sciences.

The study was published in the science journal, Proceedings Of The Royal Society Of London early this year.

"What's the molecular basis of this difference (between dorsal and ventral patterning)? That was the question I wanted to answer," she added.

To pinpoint the gene's role in the squinting bush brown, Ms Prakash disrupted the gene's function in the butterfly's eggs using a gene-editing tool, called CRISPR/Cas9, and waited for caterpillars to hatch and mature into butterflies for observation.

The set of CRISPR/Cas9 experiments was not without its challenges.

For one, the fact that the gene is also essential for the development of a butterfly's nervous system made her experiments more tricky; disrupting an important gene like apterous A may not allow the butterflies to reach adulthood, she said.

Ms Prakash finally saw success with her experiments after screening about 100 butterflies, and something was different in her fluttering friends: additional eyespots had appeared on the dorsal surfaces, as many as those on the ventral sides.

Among other findings, she had found apterous A to be a gene that inhibits eyespot patterns, but only on the dorsal surface.

She suggests the gene could be used as a biomarker to study the patterns of more colourful butterflies, such as the morpho butterfly, whose wings are covered with microscopic scales of magnificent blue.

"Because apterous A is only expressed on the dorsal surface, we can use it to pull out the cells that make these blue scales and study how only certain colours are created in butterflies," she said.

But while a butterfly's wings are often thought to be like a painting, their wing surfaces are more than just pretty pictures.

According to Ms Prakash and her supervisor, Associate Professor Antonia Monteiro, the two surfaces of a butterfly's wing serve to communicate different things in the animal kingdom.

For example, when the squinting bush brown butterfly rests with its wings closed, the dull brown parts of the ventral surface of the wing can look like a dead leaf, making the butterfly invisible to its predators, said Prof Monteiro.

However, some butterflies have brightly coloured patterns on their wings, but for different reasons, Ms Prakash said. "If the butterflies want to show predators that they're toxic, then they can have bright patterns on their ventral surfaces, which is what everyone sees.

"But if they want to specifically communicate only with the opposite sex or attract mates, then they can have brighter colours on the hidden (dorsal) surface, which won't get them caught by predators."

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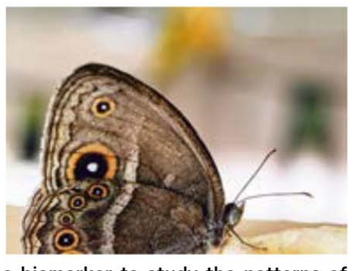
Left: Associate Professor Antonia Monteiro (at left) and PhD student Anupama Prakash, whose study was published in the Proceedings Of The Royal Society Of London early this year. PHOTO: LIN ZHAOWEI FOR THE STRAITS TIMES



The apterous A gene could be used as a biomarker to study the patterns of colourful butterflies such as the morpho butterfly (left), said Ms Prakash. The African squinting bush brown butterfly (right) is not colourful but it has eyespots. PHOTOS: AGENCE FRANCE-PRESSE, LIN ZHAOWEI FOR THE STRAITS TIMES