How the 100th protein structure solved at Diamond impacts our understanding of how insects smell

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This cartoon structure of the silkworm moth GOBP2 bound to an analogue of its sex pheromone, shows binding to the arginine amino acid (blue and green ball and stick) at the entry to the binding pocket. Credit: Birkbeck, University of London; Rothamsted Research; Diamond Light Source

New research announced today, Wednesday 30th September, by a team of leading scientists working with the UK's national Synchrotron, Diamond Light Source, could have a significant impact on the development and refinement of new eco-friendly pest control methods for worldwide agriculture.

Published in the *Journal of Molecular Biology*, the study was carried out by Dr Jing-Jiang Zhou and colleagues at the world's oldest agricultural research centre and the largest UK facility, Rothamsted Research, in collaboration with Professor Nick Keep's group from the Institute of Structural and Molecular Biology at Birkbeck, University of London.

Dr Jing-Jiang Zhou, Senior Research Scientist in insect molecular biology at Rothamsted Research, studies insect olfaction and chemical ecology at the molecular level, he explains, "Using Diamond Light Source's intense X-rays, we unravelled the detailed mechanisms linked to pheromone detection which dictates mating behaviour in silkworm moths. They are a model organism and any new insights into the working of their olfactory system has repercussions on our global understanding how insects locate mates and their hosts."

Solving this protein structure also represents a significant achievement in the advance of structural biology in the UK and it marks the 100th new structure identified at Diamond since its opening in 2007.

Professor Dave Stuart, Life Sciences Director at Diamond Light Source adds: "It is a milestone and it illustrates the fascinating range of structural biology being undertaken in the UK. Congratulations to the Rothamsted and Birkbeck groups; thanks to productive groups like these, there is currently an exponential growth in the number of structures solved at Diamond."

The importance of understanding how insects 'smell' and how the chemical signals are recognised is useful for many things, but especially for pest control in agriculture. Determining the composition and processes behind the olfactory functions of insects feed directly in to the development and refinement of new pathways to influence insect host locating behaviours. Plants use chemical signals to repel and attract insects and by harnessing a detailed understanding of the signals, farmers can plant companion species to create 'odours' that would make an area very unattractive or attractive to insects according to what they require.

This is more commonly known as the push-pull system.

Many insects depend on chemicals like pheromones to communicate with each other and to find a suitable mate. There are two main sex pheromone components bombykol and bombykal in the silkworm moth. Bombykol, the first insect pheromone discovered 50 years ago is the only component involved in mating behaviour whereas bombykal is an antagonist.

Dr Jing-Jiang Zhou, adds: "So far, we know that odorant binding proteins [OBPs] within the organism pick up pheromones at pores on the outside of the antenna and carry them through a watery layer to the nerve endings. But it is not clear whether they simply transport and release molecules which bind to olfactory receptors or whether they form a specific OBP- pheromone complex which then activates the receptor. The structures we determined using the crystallography capabilities at Diamond give us a view of how these processes work."

Prof. Stuart explains how crystallography helps: "Studying proteins and the role they play within organisms is like having a 100 locks and keys in front of you and not having any idea as to what fits what…By solving the structure of these proteins, we understand more about their function and matching them becomes much easier."

Dr Zhou concludes: "It's not just the farming community which stands to benefit from this work. These new insights will be fed into the development and refinement of biosensors where detection sensitivity is paramount in areas like blood tests. One of our spin-off companies are also investigating how bees can detect some small quantities of explosives and stand to benefit from any knowledge we generate."

Source: Diamond Light Source