Breaking through insect shells at a molecular level

February 3 2016

Light microscopy image of a live Drosophila that was unable to produce enough growth factor idgf6 due to a genetic modification. As a result, defects can be seen in the respiratory organ as well as in the chitinous shell. Credit: Dr. Matthias Behr

With their chitinous shells, insects seem almost invulnerable – but like Achilles' heel in Greek mythology, their impressive armor can still be attacked. Researchers at the universities of Bonn and Leipzig studied fruit flies (Drosophila) and discovered the molecular processes that are able to break through this protective casing. The enzyme chitinase 2 and growth factor idgf6 are especially important in correctly forming the insects' shells. These findings are relevant for fighting parasites, and will be published in the professional journal *Scientific Reports*.

The same things that work with fruit flies (Drosophila) – one of developmental biologists' favorite animals to study – can generally also be applied to other insects. The deactivation of chitinase 2 and/or idgf6 genes results in a fragile shell that does not support adequate protection for larva of fruit flies and very likely other insects such as mosquitos. "Pathogens can then easily infiltrate the animals, and they usually die during the larval stage," says Assistant Professor Dr. Matthias Behr, who transferred from the Life & Medical Sciences (LIMES) Institute at his alma mater in Bonn to the Sächsische Inkubator für die klinische Translation (SIKT) at the University of Leipzig. The project was financed with funding from Special Research Area 645 at the University of Bonn.

The objective: tailor-made inhibitors

The current discovery offers completely new starting points for keeping agricultural parasites as well as dangerous disease-carrying insects in check. The enzyme chitinase 2 and growth factor idgf6 are essential for shell formation in nearly all insects, as well as in arthropods like crabs and spiders. "However, there are minor species-related differences that could allow us to develop tailor-made inhibitors that will prevent proper development of the chitinous shell in certain species," says first author Yanina-Yasmin Pesch from the LIMES Institute at the University of Bonn. Specially developed substances could be used to attack the chitinous covering of one arthropod species while leaving other species unharmed.

Dr. Behr names two examples of possible applications: the spotted-wing drosophila (Drosophila suzukii) that recently migrated to Germany, and the new Zika virus pathogen. The spotted-wing drosophila causes enormous damage for the agricultural industry because it attacks a large volume of ripening fruit. The Zika virus is transmitted to people through mosquito bites. This virus is suspected of causing birth defects in Brazil,

among other places. The researchers hope their discovery will make it easier to fight these kinds of dangerous insects in the future.

Supposed degradation enzyme helps build up shells

The researchers from the universities of Bonn and Leipzig, as well as from the Max Planck Institute of Biophysical Chemistry in Göttingen, turned up one other surprising find: "Until now, scientists assumed that chitinase 2 was a degradation enzyme," reports Pesch. "But surprisingly, it has now been found that the enzyme is essential in forming the chitinous shell." When the protective casing is being created, chitinase shortens the chitin to the right length. The precisely tailored components are then combined with other materials to build the shell.

As the team of researchers already showed in a previous study, the "Obstructor-A" protein plays a key role here. Like a construction-site manager, it makes sure that various building materials are added to the protective shell in the right places. "Step by step, our research is revealing molecular details about the insects' Achilles heel," says Dr. Behr.

More information: Yanina-Yasmin Pesch et al. Chitinases and Imaginal disc growth factors organize the extracellular matrix formation at barrier tissues in insects, *Scientific Reports* (2016). DOI: 10.1038/srep18340

Provided by University of Bonn

Citation: Breaking through insect shells at a molecular level (2016, February 3) retrieved 26 April 2024 from https://phys.org/news/2016-02-insect-shells-molecular.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.