New insights into the physiology of cockroaches

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A study by scientists from the University of Valencia sheds new light on how the cockroach organism works. A research team from the Cavanilles Institute for Biodiversity and Evolutionary Biology, led by professors Amparo Latorre and Andrés Moya, has shown why the German cockroach (Blatella germanica) eliminates excess nitrogen by excreting ammonia, in contrast to most terrestrial insects that commonly produce uric acid as a waste compound. The research is published November 13 in the open-access journal *PLoS Genetics*.

The biochemical explanation of nitrogen secretion as ammonia in cockroaches, something that has puzzled insect physiologists for years, was determined from the whole genome sequence of the German cockroach's bacterial endosymbiont - Blattabacterium strain Bge, a bacterium living within cockroach cells - and the inference of its metabolic network. In order to produce ammonia "the bacterial metabolism employs an apparently inefficient mechanism: bacterial enzymes simultaneously synthesize, by an energetically expensive pathway, and destroy the same molecule, urea", explains Amparo Latorre of the University of Valencia. The authors point out that this surprising mechanism makes sense when considering the metabolic interaction between endosymbiont bacteria and their host and the whole physiology of the cockroach.

This research also suggests an evolutionary convergence at the level of biochemical functions in the cockroach and other omnivorous insects. The scientists analyzed endosymbiont genomes from the German

cockroach and two species of ants (Blochmannia floridanus and B. pennsylvanicus) and compared them to endosymbiont genomes from other insects with very specialized diets, such as aphids. These studies show that, by completely independent evolutionary pathways and most likely due to their omnivorous habits, cockroaches and ants have arrived at remarkably similar metabolic solutions through their old associations with endosymbionts belonging to very distant bacterial lineages.

Latorre concludes that "a better knowledge of the evolutionary mechanisms behind the symbiotic associations between insect and bacteria is necessary not only to understand the basic physiology and behaviour of the host, but also to design new strategies in pest control".

More information: López-Sánchez MJ, Neef A, Peretó J, Patiño-Navarrete R, Pignatelli M, et al. (2009) Evolutionary Convergence and Nitrogen Metabolism in Blattabacterium strain Bge, Primary Endosymbiont of the Cockroach Blattella germanica. *PLoS Genet* 5(11): e1000721. doi:10.1371/journal.pgen.1000721

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