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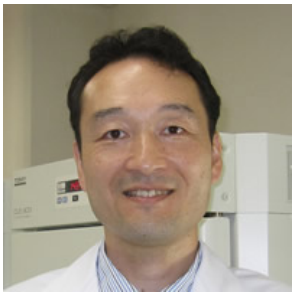
Research highlights

Innovative research with potential for pest control: Evolution of a novel organelle in Animalia



Atsushi Nakabachi

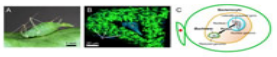


Fig.1: Aphids show integration with bacteria to the extent of 'organellogenesis' (A) Adult aphid giving birth to an offspring. (B) The protein (green signal) is localized in Buchnera within the bacteriocyte. n, nucleus; b, Buchnera. (C) The intimate aphid-Buchnera symbiosis is achieved using a mechanism that is common to the evolution of organelles, mitochondria and chloroplasts.

Mitochondria and chloroplasts are descendants of bacteria that were engulfed by ancient unicellular organisms more than a billion years ago. During their evolution, many genes were transferred from ancestral organelles and other bacteria to the host genome. This process required incorporating intact genes into the host genome, acquiring the expression signals that enable their transcription in eukaryotic hosts, and evolving a targeting system to transport and import their protein products into the endosymbiotic organelles.

The advent of this protein-targeting machinery is commonly assumed to be the most crucial step when an endosymbiont becomes an organelle. Although bacterial lineages have repeatedly evolved intimate symbioses with eukaryotic hosts, the establishment of the protein translocation system has been observed only in the cases of bona fide organelles and a symbiosis in an amoeba.

Now, Atsushi Nakabachi at Toyohashi Tech and his colleagues report this type of evolution in Animalia.

Aphids, sap-sucking insects known as agricultural pests, harbor the obligate mutualistic symbiont, *Buchnera aphidicola*, within specialized cells called bacteriocytes. *Buchnera* provides nutrients to the host aphids and has been transmitted through host generations for more than 100 million years.

The present immunochemical study revealed that (i) protein is synthesized from an aphid-encoded gene that was horizontally acquired from a bacterium; (ii) the protein is synthesized specifically in the bacteriocyte; and (iii) the synthesized protein is localized in *Buchnera*, indicating that a translocation system has evolved to target the protein to *Buchnera*. This is the first report of integration between multicellular eukaryotes and bacteria to the extent of 'organellogenesis'.

These findings are expected to lead to the development of innovative biotechnologies, including the fusion of distantly related organisms, and will enable highly selective pest control.

Reference:

- Authors: Atsushi Nakabachi[1,2], Kinji Ishida[3], Yuichi Hongoh[4], Moriya Ohkuma[2], Shin-ya Miyagishima[5]
- Title of original paper: Aphid gene of bacterial origin encodes a protein transported to an obligate endosymbiont.
- Journal, volume, pages and year: *Current Biology* **24**(14), R640–R641 (2014).
- Digital Object Identifier (DOI): 10.1016/j.cub.2014.06.038
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