

Mechanism of successful horizontal gene transfer between divergent organisms explained

December 20 2016



Japanese edible ascidian, *Halocynthia roretzi*. Credit: University of Tsukuba

The transfer of genes from one organism to another is potentially a rapid way for evolution to occur and for complicated novel functions to emerge. However, even when the two organisms in question are in close proximity to each other, such as in a symbiotic or parasitic relationship, the transfer of genetic material and its introduction into a new genome only marks the initial step for successful horizontal gene transfer. It is also necessary for the gene to be expressed in a way that benefits the new host and ensures that it is passed down through the generations.

In a new discovery that increases our understanding of gene transfer, a research team centered at University of Tsukuba has studied a gene in marine invertebrates called ascidians originally came from a common bacterium. The team has revealed the likely mechanism by which this gene ended up being expressed in a functionally important and tissue-specific way.

The team focused on marine filter feeders called ascidians and their cellulose synthase gene. This gene encodes a protein that helps form an external protective coating, the loss of which leads to a lack of cellulose production and has adverse effects on these organisms. This gene is specifically expressed in the protective outer layer of cells called the epidermis, which was suggested to be key to its coating-related function.

"We showed that a region adjacent to the cellulose synthase gene is responsible for its specific epidermal expression," study coauthor Yosuke Ogura says. "Sequence analysis revealed that this region contains a binding site of a transcription factor called AP-2 and, when we induced mutations in this binding site, the expression of cellulose synthase in the

ascidian epidermis disappeared."



Ciona intestinalis. Credit: University of Tsukuba

Although all DNA sequences consists of the four letters or bases of A,

C, G, and T, their proportions differ depending on the organism. For example, in actinobacteria, over 70% of the DNA consists of Gs and Cs, while the genome of ascidians has an abundance of As and Ts. The [AP-2 binding site](#) in ascidians is actually GC-rich, suggesting it originated from another species. It turns out that this GC bias may have been key to its functional integration.

"AP-2 inherently binds to GC-rich regions, so it was already primed to start interacting with the bacterial GC-rich DNA once it had integrated into the ascidian genome," first author Yasunori Sasakura says. "The GC-specificity and epidermal expression of AP-2 meant that the introduced cellulose synthase gene could immediately be expressed in its new surroundings in a beneficial way."

These findings provide interesting insight into one way in which the conditions in the new host can facilitate expression of a newly transferred gene and its integration into the host's functions, reducing the improbability that a randomly inserted foreign gene could actually be beneficial.

More information: Transcriptional regulation of a horizontally transferred gene from bacterium to chordate, *Proceedings of the Royal Society B*, [rspb.royalsocietypublishing.org1098/rspb.2016.1712](https://rspb.royalsocietypublishing.org/doi/10.1098/rspb.2016.1712)

Provided by University of Tsukuba

Citation: Mechanism of successful horizontal gene transfer between divergent organisms explained (2016, December 20) retrieved 3 May 2024 from <https://phys.org/news/2016-12-mechanism-successful-horizontal-gene-divergent.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.