No. 2043

Molecular and Neural Mechanisms of Salt Chemotaxis Learning

Hirofumi Kunitomo[1], Chanhyun Park[1], Hirofumi Sato[1], Haruo Ogawa[2], Yuichi Iino[1]

[1.] Department of Biological Sciences, School of Science, The University of Tokyo
[2.] Institute for Quantitative Biosciences, The University of Tokyo

Summary

Taste preference is determined by environmental factors such as dietary habits as well as by genetic factors. It is proposed that an associative learning of taste experience and emotion upon eating plays an important role in formation of taste preference. However, mechanisms as to how sensory information and internal state of the brain are integrated and memorized, and how feeding behavior is regulated based on the memory are not fully understood. Taste-dependent learning is an essential ability for animals to adapt to the natural environment, therefore such ability is found even in animals with a simple nervous system. The soil nematode *Caenorhabditis elegans* migrates toward the salt concentration at which it has been fed, while avoid the concentration at which it experienced starvation. Preference for a particular salt concentration depends on either food or salt-concentration conditions. Therefore, salt chemotaxis of *C. elegans* is a form of associative learning in which food and salt concentration are memorized (salt concentration learning). Our goal is understanding of the mechanisms by which exploratory behavior is regulated based on memory at the molecular and cellular level. In this study, we elucidated the function of a ClC channel of *C. elegans* whose mutations resulted in defects in salt concentration learning.

Through genetic analyses of the mutants, we identified two independent missense mutations in the *clh-1* gene as the responsible factor for salt concentration learning. *clh-1* is one of the six ClC anion channel/transporter genes of *C. elegans*. Interestingly, loss of function of *clh-1* showed no defects in salt chemotaxis, suggesting that the mutations conferred a novel activity to the CLH-1 channel in the mutants. Functional imaging approaches revealed that CLH-1 contributes to the salt response of a gustatory neuron through regulating intracellular chloride ion concentration. Salt response of the gustatory neuron as well as the responses of the postsynaptic interneurons that regulate exploratory behavior were severely weakened in the mutants. ClC channels are conserved in humans, and some are involved in genetic diseases. Our results may contribute to understanding the roles of ClC channels in the nervous system in higher organisms.