Functional changes of thermosensory molecules related to environmental adaptation

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Animals have adapted to diverse thermal environments from cold to hot. During the course of thermal adaptation processes, preferred thermal ranges for survival shift among species adapted to different thermal niches. Accordingly, evolutionary changes of thermal perception must be required during thermal adaptation. To understand the molecular basis for the shift in thermal perception, the researchers compared the functional properties of thermal sensors among clawed frog species adapted to different thermal niches in Africa.

In clawed frog (genus *Xenopus*), TRPV1 and TRPA1 serve as heat sensors in thermal perception. In their previous study, heat responses of TRPV1 have been reported to differ between *Xenopus laevis* and *Xenopus tropicalis* adapted to cool and warm niches, respectively. Upon heat stimulation, *X. laevis* TRPV1 showed a maximum response from the first stimulation, while *X. tropicalis* TRPV1 showed only a small response in the first stimulation and its responses became gradually larger upon repeated heat stimulation.

In the present study, the researchers newly analyzed two species adapted to warm (*Xenopus muelleri*) and cool niches (*Xenopus borealis*). TRPV1 from these two species exhibited heat responses similar to *X. laevis* TRPV1. To elucidate the functional evolutionary process of TRPV1, ancestral proteins of TRPV1 was inferred and artificially reconstructed. Reconstructed ancestral TRPV1 also showed heat responses similar to *Xenopus laevis*, suggesting that TRPV1 heat responses specifically changed in the lineage leading to *X. tropicalis*. However, similar functional shift of TRPV1 did not occur from the ancestor to *X. muelleri*, therefore changes in the TRPV1 heat responses is not always linked with niche selection in the *Xenopus* evolutionary process.

On the other hand, comparison of TRPA1 among four *Xenopus* species revealed that heat-evoked activity of TRPA1 from cool-adapted species was considerably higher than that of TRPA1 from warm-adapted species. This finding suggests that the species adapted to cool niches increased the activity of a heat sensor (or vice versa) in order to sharply respond to heat exposure. Therefore, this study illuminated the importance of thermal sensors in environmental adaptation.

More information: Shigeru Saito et al, Elucidating the functional evolution of heat sensors among Xenopus species adapted to different thermal niches by ancestral sequence reconstruction, *Molecular Ecology* (2019). DOI: 10.1111/mec.15170

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