

Study identifies gene conferring novel function to seahorse brood pouch

July 24 2023

Novel Orphan Gene Identified in Seahorse Flame Cone Cells

Flame cone cells—specialized cells that protrude above the skin surface—surround the brood pouch and spines, and are unique to seahorses

Understanding the genetic mechanism behind flame cone cell development in seahorse brood pouches

- Morphological and structural characterization
- Brood pouch RNA-seq analysis
- Gene expression pattern analysis
- Protein expression and localization analysis
- Gene evolutionary pathway analysis

Outer epithelium of seahorse brood pouch is heavily populated with flame cone cells

Flame cone cells express the pgrich orphan gene

pgrich is involved in the formation of flame cone cells

There is an evolutionary connection between pgrich and elastin genes

The pgrich gene evolved and obtained a novel function to form the flame cone cells in seahorses

Orphan gene expressed in flame cone cells uniquely found in seahorse epithelium
Kawaguchi et al. (2023) | Cell and Tissue Research | DOI: 10.1007/s00441-023-03779-1

上智大学 SOPHIA UNIVERSITY

The brood pouch and flame cone cells are unique to seahorses and pipefish. However, little is known about the evolutionary history of this organ and the flame cone cells. Researchers in Japan have identified an orphan gene that is only expressed in the flame cone cells and is likely linked to the development of the brood pouch. Credit: Mari Kawaguchi from Sophia University

Teleost fish encompass a diverse group, among which seahorses display a unique morphology. The characteristic spines and brood pouch seen in

seahorses feature distinctive epithelial cells—called flame cone cells—covered by a mucous cap.

However, these cells are not found in the barbed pipefish *Urocampus nanus* or the seaweed pipefish *Syngnathus schlegeli*, close relatives of the seahorse, belonging to the Syngnathidae lineage. While research has hypothesized the function of the flame cone cells, their evolutionary origins have remained a mystery.

Now, a team of scientists led by Assoc. Prof. Mari Kawaguchi and Prof. Shigeki Yasumasu from the Department of Materials and Life Sciences at Sophia University have identified an "orphan" gene—a gene with no identifiable homologous sequences in other species or lineages—in the seahorse *Hippocampus abdominalis*. They believe that this gene, called the proline-glycine rich (pgrich) gene, is linked to the development of the flame cone cells in the brood pouch. Their findings were published in the journal *Cell and Tissue Research*, on 25 May 2023.

Expanding the reason behind pursuing this investigation, Dr. Kawaguchi says, "Seahorses have fascinating morphology, and males carry embryos in their brood pouch. The occurrence of male [seahorses](#) giving birth is a [rare phenomenon](#) in the [animal kingdom](#) and makes the seahorse a model organism to study evolution. We were keen to identify the [genes](#) responsible for forming the flame cone cells in the brood pouch."

The team first paired histological staining with [electron microscopy](#) to confirm that the flame cone cells were present on the outer epithelium of the brood pouch in *H. abdominalis*, but not in *U. nanus* or *S. schlegeli*. Next, in situ hybridization and immunohistochemical methods revealed that the pgrich gene was expressed and its protein was localized in flame cone cells of the body surface.

The amino acid sequences of protein product of pgrich gene, PGrich

showed partial similarity with the translated amino acid sequence deduced from the antisense strand—the noncoding part—of greater pipefish elastin gene. Through sequence analyses, the team uncovered many [transposable elements](#) around the pgrich gene. They propose that the pgrich gene might have evolved from the elastin gene in pipefish and subsequently obtained a novel function in the formation of flame cone cells, which are unique to seahorses.

As the team continues to piece together the evolution of the seahorse brood pouch, Dr. Kawaguchi concludes, "The evolutionary history of the pgrich gene may provide clues as to how the orphan gene came to be and how the [brood pouch](#) developed in this lineage. Seahorses are popular in home aquariums, and understanding these phenomena will contribute to people's fascination with these fish."

More information: Mari Kawaguchi et al, Orphan gene expressed in flame cone cells uniquely found in seahorse epithelium, *Cell and Tissue Research* (2023). [DOI: 10.1007/s00441-023-03779-1](https://doi.org/10.1007/s00441-023-03779-1)

Provided by Sophia University

Citation: Study identifies gene conferring novel function to seahorse brood pouch (2023, July 24) retrieved 2 May 2024 from <https://phys.org/news/2023-07-gene-conferring-function-seahorse-brood.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.