

Genetic mechanisms of shell growth and shell coiling

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Molluscan shells have been a focus of study in the global environmental changes and morphological evolution, because they have a rich and continuous fossil record throughout the Phanerozoic. The knowledge of development and growth of the shells is important to reveal their morphological evolution, which may well be related to global environmental changes. Although theoretical aspects of the shell growth have been explored extensively, the biological reality of shell growth, such as the molecules and genes related to the theoretical parameters, remained largely unexplored. However, a clue has been found in recent years, that is, Dpp. It is the transcription product of *dpp*, which is the homologous gene of *bmp 2/4* in vertebrates. It has been shown that *dpp* is an important factor for shell formation and shell coiling. In this study, we focused on another signaling protein important in development. To investigate the function of this protein to *Lymnaea stagnalis*, we used an inhibitor and an activator. We found that these signals are heavily associated with the development and growth of embryos. In particular, the phenotypes of the shell form observed when the embryos were activated at the veliger stage demonstrated that the activity of these signals likely control the speed of the shell growth and the extent of shell coiling.