Physiological roles of dopamine receptors in response to reproduction in the brain of two teleost species

Name: BYUN JUNHWAN

Title : Physiological roles of dopamine receptors in response to reproduction in the brain of two teleost species (硬骨魚類の脳におけるドーパミン受容体の生殖生理的役割)

Abstract

Environmental factors such as light play critical roles in controlling the physiological and behavioral events in fish. Depending on their habitat depth, fish recognize different wavelengths of light. A change in this wavelength is perceived by sensory organs and converted to internal stimuli, then conveyed to neural and peripheral tissues. A photoreceptor is a visual sensory cell, which is capable of recognizing a specific range of light wavelengths. Melatonin is an endogenous indoleamine that has crucial roles in delivering external cues to the brain and synchronizing physiological processes by stimulation of the endocrine system. These signals control the dopaminergic system in the brain. This study aimed to explore how light signals regulate the reproductive systems of fishes (a nocturnal species, the Japanese eel *Anguilla japonica*, and a diurnal species, the sapphire devil *Chrysiptera cyanea*) through the actions of melatonin and dopamine. The Japanese eel results showed that the expression levels of short-wavelength sensitive opsin 2 increased in the three parts of the brain during sexual maturation, while the expression levels of gonadotropin-releasing hormone 1 (*gnrh1*) and luteinizing hormone β-subunit (*lhβ*) increased in the midbrain and pituitary, respectively. Intraperitoneal administration of melatonin resulted in downregulation of the D2B receptor in the mid-brain and upregulation in the pituitary of Japanese eel, while injections of dopamine and melatonin downregulated and upregulated follicle-stimulating hormone β-subunit (*fshβ*)/*lhβ* transcription in the pituitary, respectively. These results suggest that the abundances of *fshβ* and *lhβ* are regulated through melatonin and dopamine. In contrast, the day-night pattern of dopamine receptor activity differed among subtypes in the sapphire devil during the vitellogenic stage. Melatonin had a positive effect on reproduction in immature individuals when the dopaminergic system was inhibited. The physiological roles of melatonin in controlling reproduction-related genes (*gnrh1*, *fshβ*, and *lhβ*) changed according to maturity in the sapphire devil because opposite effects of melatonin and dopamine were observed in mature fish. These results suggest that fish undergoing periodic reproduction in a light environment perceive changes in the environment through photoreceptors, then transduce these changes into internal signals, including melatonin and dopamine. The melatonin and dopaminergic systems act coordinately in the brain to stimulate the hypothalamic-pituitary-brain axis during reproduction. In conclusion, a common system perceiving and transducing the periodic changes in the environment exists in fishes; moreover, responsiveness to reproduction differs among nocturnal and diurnal species according to their reproductive strategies.