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

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Abstract

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

Environmental factors including light play a critical role in controlling the physiological and behavioural events in fish. Depending on their habitat depth, fish recognize different wavelengths of light. Change in this wavelength is perceived by sensory organs, converted to internal stimuli, and, eventually, conveyed into neural and peripheral tissues. A photoreceptor is a visual sensory cell, which is capable of recognizing a specific range of light wavelength. Melatonin as an endogenous signal has a crucial role in delivering external cues to the brain and synchronizing the physiological processes by stimulating the endocrine system. This indoleamine is known to control the dopaminergic system in the brain. The aim of this study was to explore how light signal regulates the reproductive system of fishes (Japanese eel *Anguilla japonica* as a nocturnal species, and sapphire devil *Chrysiptera cyanea* as a diurnal species) through melatonin action and dopaminergic activity. The results using the Japanese eel showed that, in the progress of sexual maturation, the expression levels of short wavelength sensitive opsin 2 (SWS2) increased in the three parts of brain, and that those of gonadotropin-releasing hormone 1 (*gnrh1*) and gonadotropin-releasing hormone 1 (*gnrh1*) and luteinizing hormone β -subunit (*lh\beta*) increased in the mid-brain and pituitary, respectively. In the case of the Japanese eel, an intraperitoneal administration of melatonin resulted in downregulation of D2B receptor in the mid-brain and upregulation in the pituitary, while that of dopamine and melatonin downregulated and upregulated the transcription of *fsh\beta/lh\beta* in the pituitary, respectively. It is suggested that abundance of *fsh\beta* and *lh\beta* is regulated through melatonin and dopamine. In the case of the sapphire devil, on the other hand, a day-night pattern of dopamine receptors at vitellogenic stage was different among subtypes. Melatonin was a positive effect on reproduction in immature individuals, when the dopaminergic system was inhibited. It is concluded that fishes undergoing a periodic reproduction under light environments perceive changes in environments by photoreceptors and transduce them into internal signals including melatonin and dopamine, and that the melatonin and dopaminergic systems coordinately act in the brain and stimulate the hypothalamic-pituitary-brain axis in the reproduction. This system transducing the periodic changes in environments is different among fish, according to their reproductive strategies.

Name BYUN JUNHWAN