サンゴ礁魚類の環境感受・伝達に果たす脳内モノアミン活性に関する研究

Form 3

Abstract

Title: Studies on monoaminergic system in relation to environmental perception in the brain of coral reef fish

Fishes perceive changes in environmental cues through sensory organs, transduce them as internal signals, and activate the hypothalamus-pituitary-gonadal (HPG) axis to initiate and terminate the reproductive activity. To date, it is not known how the HPG axis is activated by external stimuli. The aimed of the present study was to examine whether periodical changes in environmental factors such as hydrostatic pressure and photoperiod influence the HPG axis in fishes. Special attention was paid to monoaminergic activity in the brain. Exposing the three spot wrasse *Halicoeres trimaculatus* to hydrostatic pressure at a 3-m depth (~30 KPa) had an impact on a ratio of dopamine (DA) and DA metabolite (DOPAC);DOPAC/DA decreased within 6h in the brain. Production of 17α,20β-dihydroxy-4-pregnen-3-one was stimulated in the ovaries of the pressurized fish, suggesting that hydrostatic pressure activates final oocyte maturation through brain monoaminergic activity. The relationship between photoperiodicity and dopaminergic activity was examined using the sapphire devil *Chrysiptera cyanea*. Light-dark cycle, but not constant conditions, influenced DA, DOPAC and its ratio in the brain; DOPAC and DOPAC/DA increased under LD 14:10, while DA increased under LD 10:14. When the sapphire devil were exposed to melatonin-containing water, DOPAC and DOPAC/DA, but not DA, decreased within 6 h after treatment. Melatonin stimulated a DA release into the medium. In addition, active vitellogenesis in females during the reproductive season was suppressed by melatonin. These results indicate that day-length alters DA metabolism in the brain of the sapphire devil through melatonin oscillation caused by external light stimuli. Treatment of the sapphire devil with a neurotoxin, 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridin (MPTP), at concentrations of 0.02 and 0.2 μg/ml for 2 days showed dose dependent decreases in DA, DOPAC and DOPAC/DA in the brain. Immunohistochemistry revealed that number of tyrosine hydroxylase (TH)-positive neurons decreased in the diencephalon. These results suggest that MPTP treatment destroys TH-positive neurons in the diencephalon and lowers DA synthesis and release in the brain. Artificially retracted ovaries during the spawning season rapidly restored after MPTP treatment at 0.02 μg/ml compared with the control fish; MPTP-treated fish had high gonadosomatic index (GSI) and many vitellogenic oocytes in an ovary at 5 days. These results suggest that DA in the brain drives ovarian development in the sapphire devil. The present study also examined the effect of a DA D2 receptor antagonist (pimozide) on the gonadal development of the sapphire devil. When the artificially regressed females were treated with pimozide at 10mg/kg, rapid increases in GSI and oocytes at TYS occurred spontaneously. Since there were no differences in DA, DOPAC and DOPAC/DA levels in the brain between the treatment and control groups, DA D2 receptors in the GnRH cell bodies and GnRH pituitary terminals in the hypothalamus as well as LH-producing cells in the pituitary play a role in gonadal development in certain fish. It is concluded that dopaminergic activity in the brain acts as a mediater of environmental stimuli and drives gonadal development though acceleration and decelaration in the endocrine network of the HPG axis.

Name Badruzzaman Muhammad