Protective effect of theanine on attenuation of long-term potentiation at hippocampal CA1 synapses after acute behavioral stress

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The hippocampus plays an important role in learning, memory and recognition of novelty. The most widely accepted mechanisms of memory formation are synaptic plasticity. The mechanisms of plasticity at the Schaffer collateral/commissural synapses in the hippocampal CA1 region have been extensively studied in the brain. It is well established that long-term potentiation (LTP) at this pathway involves the synaptic activation of N-methyl-D-aspartate (NMDA) receptors. This activation plays a key role for the increase in postsynaptic Ca^{2+} concentration to lead to CA1 LTP.

Theanine (γ-glutamylethylamide) is one of the major amino acid components in green tea. When theanine is administered to rats and mice, learning behavior such as the novel object test and passive avoidance is improved. To check the effect of the intake of theanine on acute behavioral stress, in the present study, rats were bred with mother rats, which were fed a drinking water containing 0.3% theanine, after birth and then fed the same drinking water after weaning. The intake of water was almost the same between the control and theanine-treated rats and body weight was also almost the same between them. When rats were 6-week-old, they ware subjected to tail suspension stress for 30 s. CAl LTP was induced in hippocampal slices, which were prepared from rats 1 h after exposure to stress. CA1 LTP induced by tetanic stimulation (100-200 Hz, 1 s) was significantly attenuated by tail suspension stress. However, this attenuation was abolished by the intake of theanine. These results suggest that theanine has a protective effect on the attenuation of CA1 LTP after acute behavioral stress. Further investigation on the effect of theanine on learning and memory after exposure to stress is expected.