Facilitation in hippocampal neurogenesis in young rats fed theanine, an amino acid in tea leaves, and its effect on cognitive function

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The interest in green tea grows for human health. It has been reported that green tea has the putative benefits to the brain and the potential for preventive and therapeutic usefulness, especially in the elderly. Theanine, g-glutamylethylamide, is one of the major amino acid components in green tea. Theanine can counteract excitotoxicity and/or mitochondrial radical formation and theanine intake might lead to neuroprotective effects. The chemical structure of theanine is similar to that of glutamate. It is reported that theanine binds to glutamate receptors and modulates excitatory neurotransmission. Glutamate signaling is critical for hippocampal functions, which is involved in learning and memory. There is also fragmental evidence on the effect of theanine, which can pass through the blood-brain barrier, on brain function. However, the effect of theanine intake is poorly understood. In the present study, the effect of theanine intake on hippocampal neurogenesis was examined in 6-week-old rats, which were fed water containing 0.3% theanine from birth. Theanine was administered the dams during lactation. Hippocampal neurogenesis was checked 6 weeks after theanine administration. Theanine level in the hippocampus was under the detectable limit and the levels of glutamate and GABA was not appreciably changed by theanine administration. On the other hand, theanine intake significantly increases BrdU-, Ki67-, and DCX-labeled cells in the dentate gyrus 6 weeks after theanine administration. The level of brain-derived neurotropic factor (BDNF) was significantly increased 3 week after theanine administration, at which BrdU was injected into rats. In the novel object recognition memory, furthermore, the control rats showed recognition memory deficit 48 h after the training, while theanine-treated rats showed normal recognition memory. In passive avoidance performance, learning ability for avoidance performance was higher in theanine-treated rats 24 h after the training. LTP induction at the perforant path-granule cell synapse was not changed by theanine administration.

The present study indicates that theanine intake facilitates hippocampal neurogenesis followed by improved recognition memory. Neuronal circuits are shaped by experience during critical periods of early postnatal life. This shaping might be improved by the increase in neurogenesis in the dentate gyrus that is linked to the increased level in BDNF in the hippocampus.