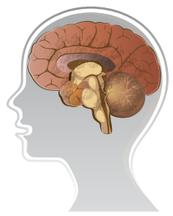
L-theanine: learning and cognition

FX Medicine

TEA DRINKING goes back at least 5000 YEARS to ancient China[1]

Second to water **TEA** is now considered the world's most **POPULAR BEVERAGE**[1]

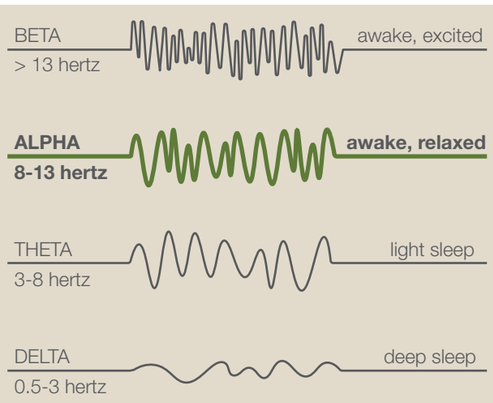
TEA has been associated with changes in body chemistry that **REJUVENATE RELAX** **ENHANCE ABILITY TO THINK** and **CHANGE MOOD**[1-3]



L-THEANINE is found almost exclusively in varieties of the **tea-producing plant** *Camellia sinensis*

L-THEANINE INCREASES ALPHA BRAIN WAVE ACTIVITY[4]

BRAIN WAVES[5-8]



The brain contains hundreds of billions of nerve cells. Researchers believe our thoughts are created when large groupings of these nerve cells "fire", or send messages to each other, through bursts of electrical activity at the same frequency. Many scientists believe that synchronised neural firing, which occurs when masses of nerve cells fire or emit electrical signals at the same frequency at the same time, lies at the root of numerous essential cognitive functions, including memory and perception.

Brain waves are divided into four different bandwidths that are believed to create a spectrum of human consciousness. Brain waves change throughout the day and are part of a feedback loop that is influenced by what we are doing, thinking and feeling emotionally – or while we sleep.

Beta waves typically dominate our normal waking states of consciousness and occur when attention is directed towards cognitive and other tasks. Beta wave activity is present when we are alert, attentive, focused, and engaged in problem solving or decision making.

Alpha waves are present when your brain is in an idling default-state typically created during daydreaming or consciously practising mindfulness or meditation. Alpha waves can also be created by doing aerobic exercise.

Theta waves occur during sleep but have also been observed in the deepest states of Zen meditation.

Delta waves are the slowest brain waves and occur primarily during our deepest state of dreamless sleep.

THE ROLE OF L-THEANINE IN LEARNING, COGNITION AND MEMORY[9-23]

STRIATUM[10-12]

Subcortical part of the forebrain and a critical component of the reward system.

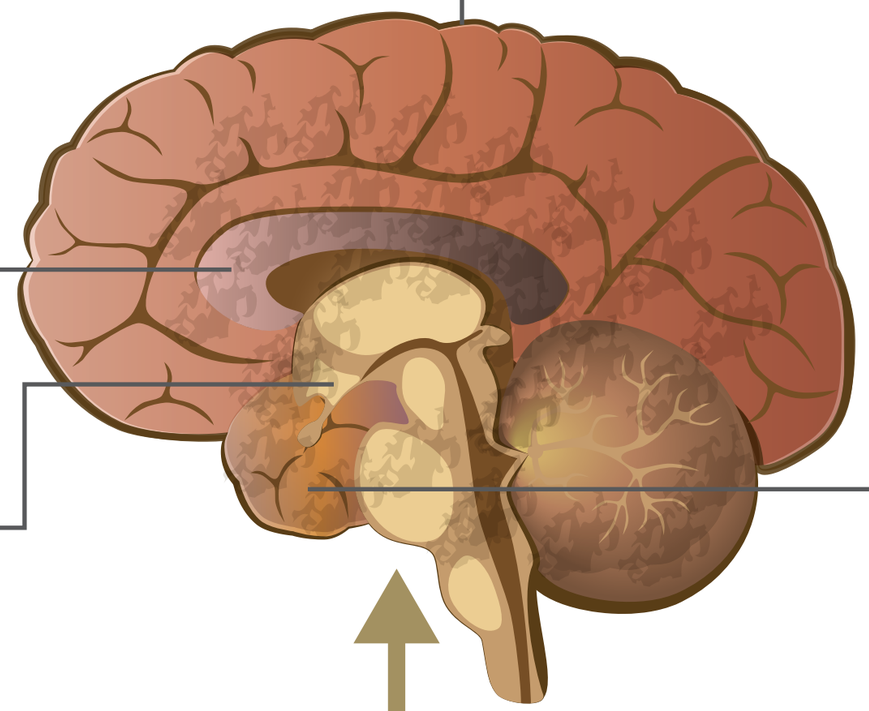
Regulates various aspects of cognition, including motor and action planning decision-making, motivation, reinforcement and reward perception.

- **Increases dopamine**
  - up-regulates synaptic plasticity
- **Increases serotonin**
  - induces 5HT-LTD, which is a unique form of synapse specific plasticity
  - influences cognition by acting as a glutamate antagonist
  - improves cognition via induction of cholinergic neurons

HYPOTHALAMUS[10,13-16]

Is part of an extensive bidirectional connective system with cortex, hippocampus, striatum and many other subcortical structures, in a manner that allows for extensive integration of cognitive and emotional information.

- **Increases dopamine**
  - essential for plastic and reward learning
  - implicated in memory and motivation
- **Increases serotonin**
  - influences cognition by acting as a glutamate antagonist
  - improves cognition via induction of cholinergic neurons



CEREBRUM[10,17-19]

The newest and largest part of the brain.

Involved in perception, imagination, thought, judgement and decision making.

- **Increases GABA**
  - increases alpha brain waves and decreases beta brainwaves
  - involved in motor sensory learning and motor cortical plasticity

HIPPOCAMPUS[10,20-23]

Part of the limbic system. Plays an important role in long-term memory and spatial navigation. In Alzheimer's disease the hippocampus is one of the first regions of the brain to suffer damage; memory problems and disorientation appear among the first symptoms.

- **Prevents stress-induced impairment of recognition memory**
- **Increases induction of LTP (strengthening of synapses)**
- **Increases dopamine**
  - up-regulates hippocampal-dependent plasticity and learning
- **Increases serotonin**
  - low serotonin strongly linked with chronic stress and reduction of hippocampal neurogenesis
  - deficiency associated with spatial learning and cognitive deficits
  - influences cognition by acting as a glutamate antagonist
  - improves cognition via induction of cholinergic neurons
- **Increases BDNF**
  - promotes synaptic plasticity which is critical for learning and memory
- **Increases nerve growth factor**
  - important for growth, maintenance and survival of neurons

GABA: gamma aminobutyric acid
BDNF: brain-derived neurotrophic factor
5HT: 5-hydroxytryptamine (serotonin)
LTP: long-term potentiation
LTD: long-term depression