

THEANINE – GREAT FOR HEALTH AND GREAT FOR TASTE

Theanine is a unique bioactive component of tea, being a non-protein amino acid found only in the *Camellia sinensis* tea plant, with the exception of a kind of mushroom, *Xerocomus badius*, and certain species of the genus *Camellia*: *C. japonica* and *C. sasanqua*. It is the major amino acid that makes up more than 50% of the total free amino acids in tea and constitutes 0.6 –3% of the dry weight of tea.

Theanine, also known as gamma-glutamethylamide, is a free amino acid and is found in tea in its D- and L- forms. Like all other amino acids, theanine has two enantiomers, L and D. So L-theanine and D-theanine are a pair of chiral compounds. Whilst D-theanine is found in much lower concentrations in tea leaves, 98% of theanine in tea is in the form of L-theanine, so most scientific studies have been based on L-theanine. (1).

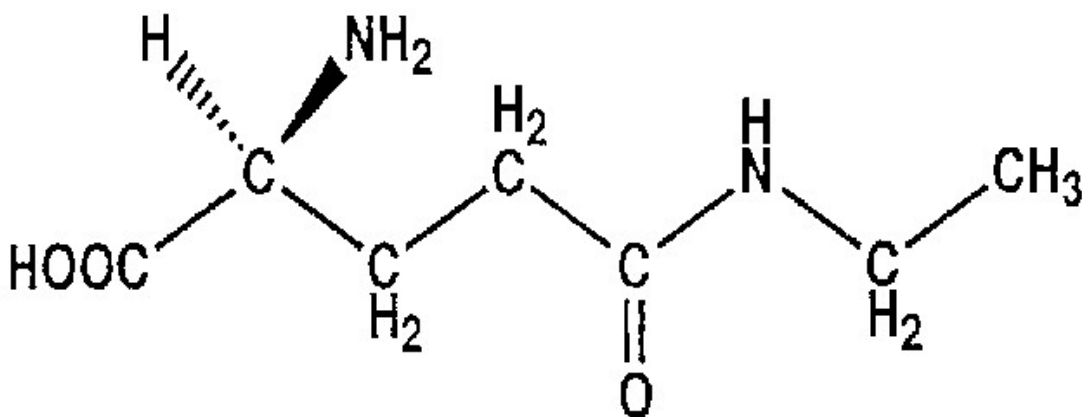


Figure 1. Chemical structure of theanine

L-theanine is the main component responsible for the savoury "umami" taste known as the exotic taste of green tea. In 1908 "umami" taste was discovered by a Japanese chemist, Dr. Kikunae Ikeda, as the fifth basic taste uniquely different from the classic four basic tastes: saltiness, sweetness, bitterness, and sourness (2).

Health Benefits of L-Theanine

Theanine is recognized to have powerful and beneficial effects on the human brain. It is abundant in all types of tea and has a valuable balancing role to the stimulating effects of caffeine - tea's other important neuroactive compound.

Animal and human studies support that L-theanine enhances cognitive performance, shows neuroprotective activity, suppresses anxiety and depression, improves sleep quality, has protective effects against cardiovascular disease, increases the antitumor activity of drugs, and contributes to strengthening the immune system.

Effects of L-theanine on cognitive functions

Theanine enhances learning and memory ability by eliminating acquired memory disorders, relieving oxidative stress, and improving the α -wave patterns of brainwaves (3).

Nobre et al. determined that L-Theanine facilitates the generation of alpha waves in the brain, which are believed to be associated with a relaxed but alert mental state. In this study, 16 of the healthy, young participants were given 50 mg of L-theanine, while 19 were given water only (placebo).

Electroencephalographs (EEG) of the participants were measured after 45, 60, 75, 90 and 105 minutes. Participants were at rest with their eyes closed during EEG recording. Participants given L-theanine had a large increase in alpha activity over time compared to placebo.

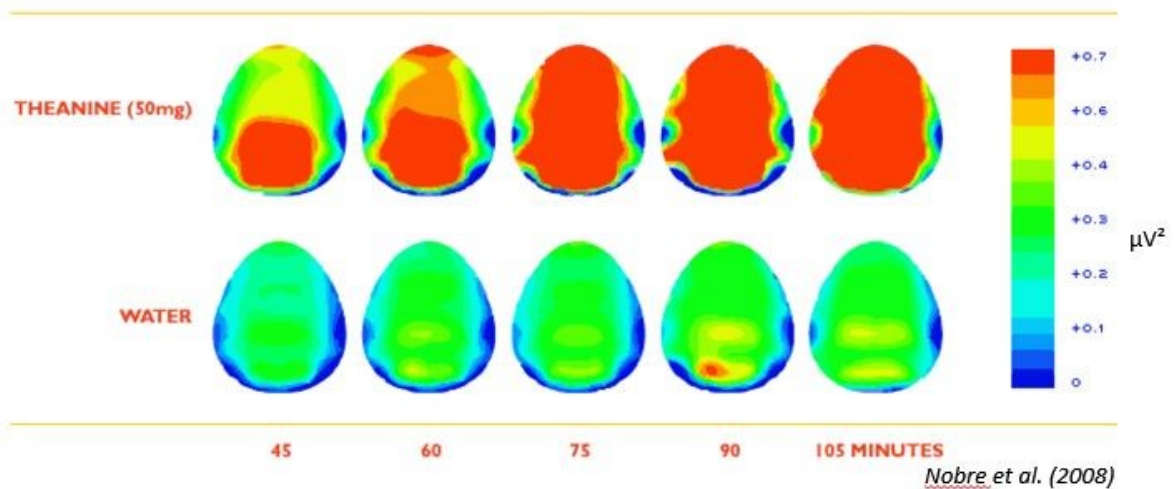


Figure 2. The L – theanine Effect on Brain Alpha Wave Activity

The increase in positive alpha wave activity at 50mg of L-theanine is shown in Figure 2. The red area represents the amount of positive alpha wave activity. The row underneath shows the control sample of someone who has only consumed water (4).

Theanine improves cognitive functions by increasing the concentration of brain neurotransmitters such as dopamine, GABA (γ -aminobutyric acid), 5-hydroxytryptamine (5-HT) and glycine. It also promotes the maturity of the nervus centralis during the neural maturation period, which is beneficial to the development of brain function (5, 6).

Neuroprotective effect of L-theanine

Theanine has distinct and important protective functions in the human brain. Theanine amino acid, which is found in its free form in green tea leaves, is easily absorbed through the intestines when taken orally, and a small amount is transported to the brain via the blood-brain barrier.

The neuroprotective effect of L-theanine (whose chemical structure is similar to that of glutamate, a very important memory-related neurotransmitter) on delayed neuronal cell death following transient ischemia has been proven by animal experiments (7,8). L-theanine provides protection against glutamate neurotoxicity due to its very affinity to bind to glutamate receptors. Kakuda et al. determined that L-theanine acts as an inhibitor of different transporters that can transport glutamine across plasma membranes towards modulation of the glutamate/glutamine cycle, which is necessary for the neurotransmitter pool of glutamate in neurons (9).

Vascular ischemia (stroke) has a high degree of morbidity and mortality, especially in the elderly. Egashira et al. showed that L-theanine reduces the effects of cerebral infarctions by showing a neuroprotective effect by preventing ischemia-induced neuronal death in CA1 region of the hippocampus of the brain (10). In another trial on mice, it was determined that theanine has a protective effect against nerve damage and protects the brain from cerebral ischemia by reducing brain infarction (11).

Theanine also shows neuroprotective activity against neurotoxin damage associated with Parkinson's and Alzheimer's diseases and can perhaps be used as an agent to prevent these diseases (12, 13).

Relaxation effect of L-theanine

L-theanine increases levels of dopamine in the brain, a natural mood enhancing compound giving feelings of enjoyment and motivation.

There are also numerous human and animal studies reporting that L-theanine has anti-anxiety and antidepressant effects.

Theanine acts as an anti-depressant by decreasing the heart rate and lowering the level of immunoglobulin A in the saliva. It is thought that due to the decrease in heart rate and immunoglobulin A, sympathetic nerve activation is weakened or the excitation of cortical neurons is suppressed, thereby reducing depression (14). Theanine also reduces the level of salivary α -amylase activity. Salivary α -amylase is an indicator of the activity of the sympathetic nervous system and its level increases in stressful conditions. However, theanine intake significantly suppresses the anxiety-induced increase in salivary α -amylase (15).

L-theanine suppresses cortical neuron excitation by inhibiting the connection between L-glutamic acid and glutamate receptors in the brain. This not only produces beneficial anti-stress effects, but also reduces anxiety and alleviates the rise in blood pressure in highly stressed adults (16).

Theanine also alleviates physical fatigue by decreasing 5-HT and serum urea concentrations while increasing dopamine and hepatic glycogen concentrations (17).

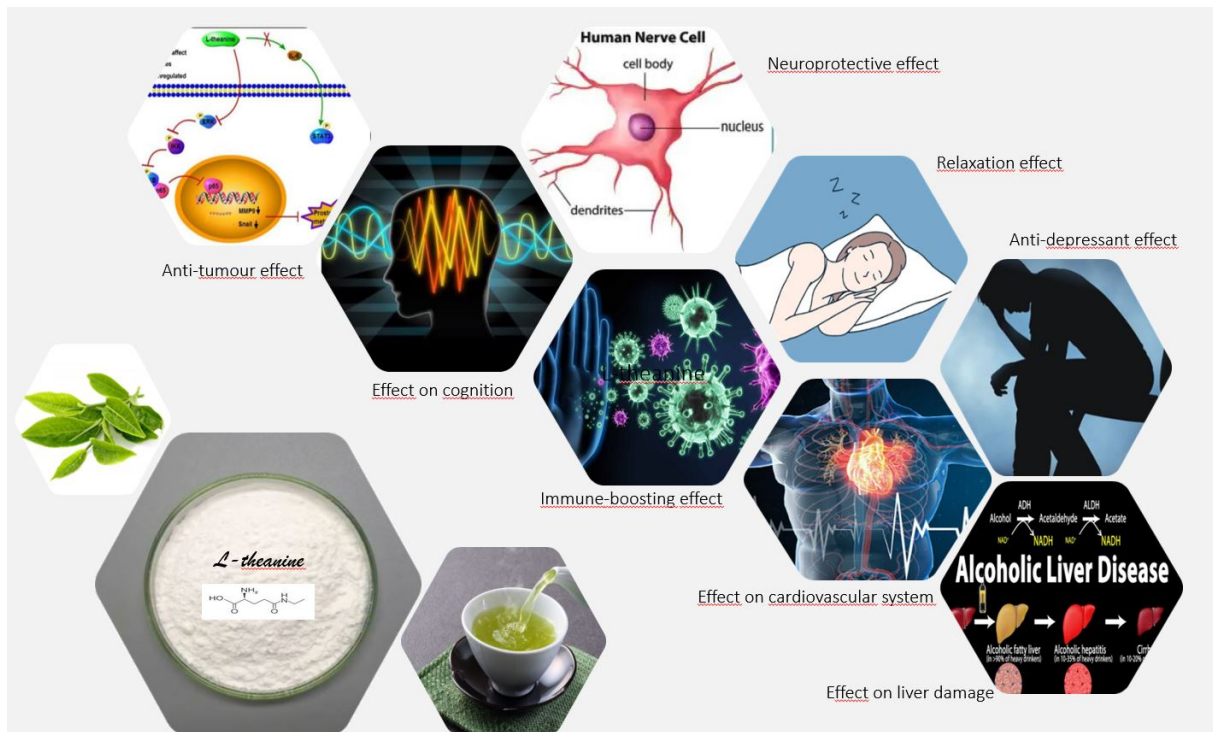


Figure 3. Health Benefits of L-theanine

Protective effect of L-theanine on the cardiovascular system

Elevated serum cholesterol level is an important risk factor for coronary heart disease. Lowering cholesterol levels reduces the risk of cardiovascular and cerebrovascular disease. In scientific studies, it has been observed that theanine taken orally improves vascular function and reduces the risk of cardiovascular disease. Theanine lowers serum cholesterol levels, increases arterial vasodilation and nitric oxide production, and protects the brain from cerebral ischemic damage (17, 18).

Anti-tumour effect of L-theanine

L-theanine enhances the antitumour activity of drugs. L-theanine inhibits the influx of glutamate into tumour cells which reduces the efflux of antitumour drugs. L-theanine enhances the antitumor activity of drugs. In a study by Sugiyama et al., it was revealed that theanine increased the concentration of the drug called doxorubicin (DOX), which is used in the treatment of cancer in ovarian cancer cells in mice, and prevented tumor development and liver metastasis. Although DOX is an effective drug in the treatment of cancer, its use is limited because it causes serious damage to normal tissues when used alone. Sugiyama et al. stated that it is beneficial to use theanine together with DOX because it reduces drug toxicity and protects normal tissues against oxidative damage caused by drugs (19). Though this is not yet demonstrated in human trails.

Theanine derivatives inhibit tumor growth. In vivo and in vitro studies have shown that theanine derivatives can help to inhibit cell growth in lung cancer (20).

The alleviating effect of L-theanine on liver damage

People who consume excessive alcohol have an increase in free radicals and lipid peroxide levels and a decrease in glutathione peroxidase activity, and this change causes liver damage. While increasing the activities of aldehyde dehydrogenase and alcohol dehydrogenase, theanine reduces liver damage caused by alcohol by lowering the level of cytochrome P450 enzyme (21).

It has been determined that 2 - 4 mg/kg body weight/day theanine consumption improves the hepatic indices by increasing glutathione level, triggering catalase and superoxide dismutase enzyme activities, and also decreasing malondialdehyde level. It has also been reported that theanine administration significantly improves liver function and reduces the level of tumor necrosis factor- α in the liver (17). Theanine reduces acute hepatic damage caused by doxorubicin used in cancer treatment (22).

Immune-boosting effect of L-theanine

In animal experiments, it has been observed that when L-theanine is administered orally together with L-cysteine amino acid, it increases the level of Immunoglobulin G and has a positive effect on the immune system, especially in the elderly. It has also been shown that the combined administration of L-cystine and L-theanine to aged mice improves immune responses by increasing glutathione synthesis (23).

The EFSA (European Food Safety Authority) has endorsed the majority of these studies in its Scientific Opinion on the validation of health claims for L-theanine from *Camellia sinensis* (24). It is worth remembering that the above-mentioned health benefits of L-theanine amino acid can be realized in the case of consumption of 200-400 mg/day. Note that a typical cup of green, black or white tea provides around 50 to 100mg of theanine.

L-theanine contents of tea types varies according to agricultural practices, the origin of the tea plant, climatic conditions, harvest type and period, and production technologies applied.

For instance, tea shoots grown in shaded conditions have higher theanine content. Similarly, theanine content is high at the beginning of the harvest period, but is lower at the end of the harvest period. While the bud has the highest amount of theanine in the harvested tea shoot, this amount decreases in the second and third leaves of the shoot.

During processing into different tea types, there is variation in theanine content depending on the growing conditions and production processes. The results of a comprehensive analytical study indicate high variability of theanine content in different types of tea (3.97–14.47 mg/g for oolong, 0.89–17.27 mg/g for black, 3.07–21mg/g for green, 18 mg/g and 2.23– 14.21 mg/g for white tea). The same study shows that the concentration of this amino acid is quite low in Pu-erh, a fermented tea type (0.07–0.26 mg/g) (25).

To summarize:

Tea is unique, as a beverage, in its ability to supply theanine. Theanine is a component that really improves the quality of tea, due to its benefits to human health and its exotic umami taste. Do not forget that every cup of tea you drink will not only give you pleasure, but also contribute to your mental and physical health.

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European Speciality Tea Association

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