



## L-Theanine (Suntheanine)

### Effects of L-Theanine, an Amino Acid Derived From *Camellia sinensis* (Green Tea), on Stress Response Parameters

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*Stress* is defined as a state of mental or emotional strain or tension resulting from adverse or demanding circumstances.<sup>1</sup> Chronic stress has the potential to precipitate an overexposure to stress-related hormones that can increase the risk of adverse health conditions, such as acute anxiety, digestive disturbances, hypertension, depression, and other stress response disorders.<sup>2</sup>

Living a healthy, balanced life in our high-stress modern society can be challenging. For many individuals, coping with multiple stressors has become the new norm. Current reports indicate that the levels of chronic stress and associated deleterious side effects have reached epidemic levels worldwide. In response to our modern day culture of stress, there has been a growing interest among individuals to embrace nutritional and lifestyle changes, as well as other holistic, integrative therapies, to help prevent and better manage the stress and its related side effects.

**L-Theanine, an amino acid found in green tea, induces a relaxation response.**

Since ancient times, drinking tea has been associated with bringing calm to both mind and spirit. Current scientific and clinical research has studied the pharmacological and physiological actions of various components of green tea, such as polyphenols, caffeine, and L-theanine constituents. More recently, L-theanine an amino acid derived from the leaves of

green tea, has been the focus of scientific and clinical research due to both its physical characteristics and its demonstrated efficacy in reducing psychological and physiological stress response parameters.<sup>3</sup>

#### BOTANICAL MEDICINE PROFILE

##### Green tea (*Camellia sinensis*; Theaceae)

When we speak of tea in Japan, there is only one tea, green tea, which is produced from the evergreen shrub *Camellia sinensis*.<sup>4</sup> For thousands of years, it has been known that drinking green tea brings health, prolonged life, and a sense of calm and relaxation.

*Camellia sinensis* is native to Southeast Asia and was brought into Japan during the eighth century AD by Buddhist monks who had been studying in China. This large evergreen shrub extends up to 30 ft in height in the wild, but under cultivation, it is typically less than 7 ft tall. Multiple branched stems, with alternately arranged lanceolate leaves, with finely serrated margins, characterize the morphology of the

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tea plant. White, aromatic flowers are found in solitary or in clusters, which are succeeded by small, brownish red capsules (fruit) that contain the seeds. The source of tea includes leaf buds and the 2 newly developed young leaves located adjacent to them, both of which produce the highest-quality tea.

Green tea is produced through the process of gentle steaming of freshly picked buds and leaves that are later dried. The heat generated from the steaming process deactivates specific enzymes that prevent the oxidation of polyphenols (catechin, epicatechin, and epigallocatechin gallate), which possess potent antioxidant and anticancer properties.<sup>5</sup>

The polyphenols found in green tea, in particular epigallocatechin gallate, is one of the most potent known antioxidants that counter the effects of reactive oxygen molecules that produce free radicals, which contribute to aging and age-related degenerative disease states. There is ever-increasing scientific evidence that supports the health benefits of regular consumption of green tea. These health benefits focus primarily on the cardiovascular system and cancer preventive action, although the clinical applications are not limited to these areas.<sup>6</sup>

More recently, research studies on green tea have focused on its beneficial effects relative to improved cognitive performance and mood. L-Theanine, an amino acid uniquely found in the leaves of the tea plant, with the exception of the mushroom *Xerocomus badius*, commonly known as Bay bolete, and a few members of the *Camellia* genus (*Camellia sasanqua* and *Camellia japonica*), is the primary chemical constituent and is known for its relaxing effect.

## L-THEANINE

### Pharmacological properties

L-Theanine (*N*-ethyl-L-glutamine) is one of the primary amino acids found in green tea. It is synthesized from glutamic acid and ethylamine in the root and then transported to the young leaves.<sup>7</sup> L-Theanine consists of 1% and 2% of the total dry weight of tea leaves and accounts for approximately 50% of the total amount of amino acids.<sup>8</sup>

As a biochemical characteristic, L-Theanine is absorbed quickly in the intestinal tract and can pass over the blood-brain barrier, with increased levels of concentration in the brain within 1 hour after administration, and begins to decrease only after a

5-hour period. Studies have shown that L-Theanine can effect the secretion and function of neurotransmitters in the central nervous system within 30 minutes of oral administration.<sup>9</sup> As a glutamate derivative, L-Theanine has an affinity to bind to the glutamate receptor subtypes, including AMPA ( $\alpha$ -amino-3-hydroxy-5-methyl-4-isoxazole-propionic acid), NMDA (*N*-methyl-D-aspartate), and kainite receptors. L-Theanine is known to block the binding of L-glutamic acid to glutamate receptors in the brain, resulting in an antistress effect through the inhibition of cortical neuron excitation.<sup>10</sup> Although L-Theanine exhibits a lower binding affinity than L-glutamic acid for glutamate receptor subtypes, several studies indicate a neuroprotective effect of L-Theanine in cortical neurons due, in part, to its antagonistic action on glutamate receptor subtype AMPA and kainite receptors.<sup>11</sup> These biochemical and functional characteristics of L-Theanine in brain dynamics suggest that it may moderately downregulate cerebral functions.

In addition to the antistress effects of L-Theanine through competitive action against excitation of glutamate receptor subtypes, neurochemical studies suggest that L-Theanine affects emotions by interacting with serotonin, dopamine (DA), and GABA ( $\gamma$ -aminobutyric acid) neurotransmitter levels in the brain. The effect of L-Theanine administration on the striatal release of DA was studied and showed significant increases in the DA levels.<sup>12</sup> Considering that the release of DA highly influences emotions, these results suggest that dose-dependent administration of L-Theanine may affect metabolism and/or the release of specific neurotransmitters in the brain. Further studies investigated the influence of L-Theanine on the synthesis or degradation of serotonin using an inhibitor of serotonin metabolism. Preliminary research has shown that following the administration of dose-dependent L-Theanine, the content of tryptophan in the brain increases significantly; however, these early studies have shown conflicting results regarding how L-Theanine affects serotonin levels.

### Effects on stress response parameters

Since physiological and emotional states are modulated by the biochemical actions of neurotransmitters and brain waves, researchers have focused attention on the psychological and

physiological affects of L-Theanine on different stress response parameters.

### **Relaxation effect**

The brain exhibits different types of brainwaves that occur at various frequencies. These brain waves are measured in cycles per second or hertz and are associated with characteristic activities that correlate with each of the frequency bands. Brain waves are frequency ranges that measure the human brain and are classified into 4 types: alpha waves (associated with a state of relaxation); beta waves (represent a state of mental activity, focused attention); delta waves (characteristic of deep restorative energy); and theta waves (represent deeply relaxed, daydreaming state).<sup>13</sup>

Studies show that L-Theanine induces alpha wave brain activity, which relates to a perceived state of relaxation. A small research study involving university students demonstrated that oral administration of 200 mg of L-Theanine (200 mg of Suntheanine standardized at 99% L-Theanine; Taiyo International, Minneapolis, Minnesota) resulted in an increase of alpha wave brain activity, representative of a sense of relaxation. Administration of L-Theanine was dose dependent (200 mg) and precipitated a relaxed, yet alert, mental state that occurred within a 40-minute time interval after oral dosing.<sup>14</sup>

### **Blood pressure–lowering effect**

Hypertension is a well-known risk factor for cardiovascular disease. Furthermore, it is known that stress can induce increased blood pressure by stimulating the nervous system to produce vasoconstricting hormones.

In a recent crossover, randomized, placebo-controlled design study, researchers investigated the effects of orally administered L-Theanine (200 mg of Suntheanine standardized at 99% L-Theanine; Taiyo International) compared with placebo on mental task performance and physiological activities under physical or psychological stress conditions. The results showed that L-Theanine significantly changed both systolic and diastolic blood pressures in the high-response group after mental tasks compared with the placebo group. At the same time, assessment of the Profile of Mood States after mental tasks demonstrated that L-Theanine reduced the Tension-Anxiety scores when compared with placebo. According to the researchers, the results suggest that L-Theanine, in addition to reducing anxiety levels, also attenuates

increased blood pressure in high-stress response adults.<sup>15</sup>

### **Improved cognitive performance**

L-Theanine has been shown to affect neurotransmitters DA, serotonin, and GABA and may modulate (tone down) central nervous system responses and regulate anxiety. It is also known that DA and serotonin are related to memory and learning ability.

The effects of L-Theanine on memory and learning parameters were investigated. Research findings consistently demonstrate that oral administration of L-Theanine (200 mg) has a positive effect on mood and cognitive performance, resulting in increased energy, clarity of thought, efficiency, increased alertness, and increased perceived work performance.<sup>16</sup>

## **SUMMARY**

L-Theanine is a unique amino acid almost exclusively found in the leaves of *Camellia sinensis* (green tea). Suntheanine is the trade name for the proprietary L-Theanine green tea leaf derivative. Scientific and clinical research has investigated the physiological and pharmacological actions of L-Theanine and has confirmed the relaxation and mood enhancement effects and other stress response parameters.

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