

L-Theanine – A unique amino acid of green tea and its physiological effects in humans.

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1. Introduction

The physiological and pharmacological actions of various components of green tea such as polyphenols, caffeine and γ -aminoisobutyric acid have been investigated⁽¹⁻³⁾.

L-theanine is a unique amino acid found in the tea plant in 1949, constitutes between 1 and 2% of the dry weight of tea leaves. It exists only in the free (non- protein) form and is the predominant amino acid component in tea, accounting for about 50% of the total free amino acids^(4,5). Its chemical structure was determined to be γ -ethylamino-L-glutamic acid (L-theanine, Fig. 1).

Natural L-theanine is synthesized from glutamic acid and ethylamine in the root of the tea plant and transferred to young leaves. Many attempts have been made to produce L-theanine on an industrial scale, however, up to now these have remained unsuccessful due to the low yields, expensive production cost and complicated processes. Recently, Taiyo Kagaku was successful in developing a safe and economical industrial method for production of L-theanine. This ingredient has been named SuntheanineTM.

We have been investigated the physiological effects of SuntheanineTM and found a variety of activities including relaxation⁶⁾, alleviation of PMS, lowering of blood pressure, improvement of cold constitution and improvement of learning performance.

2. Methods

(1) Relaxing effect

In general, animals and humans always generate very weak electric pulse on the surface of brain, called brain waves. Brain waves are classified into four kinds, named α , β , δ and θ waves according to frequency of brain waves. Each brain wave is related to individual mental condition (Fig. 2). Generation of α -waves is considered as an index of relaxation.

The volunteer test was performed to investigate mental effect of SuntheanineTM. As it was expected that mental reactivity to SuntheanineTM could be varied with anxiety level, fifty female subjects (18 – 22 years old) were divided into two groups, namely high anxiety group and low anxiety group, based on monitoring by manifest anxiety scale (MAS). Finally the test was conducted with four high anxiety female subjects and four low anxiety students. Each volunteer group was given water, 50 mg or 200 mg

Suntheanine™ solution once a week and brain waves were measured for 60 min after the administration. All measurements were repeated twice during test period for two months.

(2) Effect on alleviation of PMS

Premenstrual Syndrome (PMS) is a symptom unique to women, which appears in the luteal phase from the ovulation period through the first day of menstruation. It possesses characteristics of having a peak just prior to menstruation and disappearing 1 - 2 days following the start of menstruation. Typical symptoms of PMS are generally categorized as mental symptoms such as irritability, anger and anxiety, and physical symptoms such as sleepiness, fatigue and pains^{7,8)}.

In a volunteer study, twenty subjects were treated with tablets containing either 50 mg Suntheanine™ per tablet or a placebo. Subjects took two tablets twice a day for a total of 200 mg Suntheanine™. The test duration consisted of 3 menstruation cycles.

Test subjects were required to answer a Menstrual Distress Questionnaire (MDQ)⁽⁹⁾ survey 3 days prior to expected menstruation date and at the time of first and second administrations. The MDQ survey, developed by Moos, R, et. Al., contains 47 questions, divided into the 8 categories. Moos scores reported symptoms with six grades. For this study, four of the grades were used. Higher scores indicate an increased acknowledgement of physical and mental symptoms associated with PMS.

The first cycle was regarded as the control. Crossover tests were conducted using Suntheanine™ and / or a placebo for the second and third cycles.

3. Results

(1) Relaxing effect

In the study, α -brain waves were observed from the back to the top area of the brain surface about 40 min after the intake of Suntheanine™ solution. An oral administration of 200 mg Suntheanine™ dissolved in 100 ml of water resulted in the generation of α -brain waves in the occipital and parietal regions of the subject's brain, while only small levels of α -waves were observed in the subjects with water intake. Accumulated intensity of α -brain waves (Relative ratio) showed a dose dependent manner in the high anxiety group (Fig.3).

It is well-known fact that α -brain waves are generated during relaxed states and that the generation of α -waves is considered an index of relaxation. As shown in our results, it was suggested that L-theanine would promote the generation of α -brain waves and induce relaxed state in humans.

(2) Effect on alleviation of PMS

Suntheanine™ was found to reduce the symptoms associated with PMS, including mental symptoms such as irritation and depression, as well as physical symptoms such as headaches and abdominal pain prior to menstruation. Overall, a significant alleviation of PMS symptoms by Suntheanine™ was observed (Fig. 4).

4. Conclusions

Since ancient times, it has been said that drinking green tea induces relaxation. We investigated this particular effect and have found that L-theanine had a noticeable relaxation effect. Additionally, L-theanine was found to alleviate various symptoms of PMS.

Suntheanine™ (L-theanine) is an effective food ingredient leading to an improved quality of life.

Reference

1. Chemistry and Applications of Green Tea ed. by Yamamoto, T., et al.: pp:160., CRC-Press, New York (1997)
2. Neims, A. H. and Borstel, R. W.: Nutrition and the brain, ed. by Wurtman, R. J., Raven Press, New York:1-30 (1983)
3. Omori, M. Yano, T., Okamoto, J., Tushida, T., Murai T. and Higuchi, M.: Nippon Nogeikagaku Kaishi **61**, 1449-1451 (1987)
4. Sakato, Y.: The chemical constituents of tea. III. A new amide theanine, J. Agri. Chem. Soc. **23**, 262-267 (1949)
5. Mukai, T., Horie, H. and Goto, T.: Differences in free amino acids and total nitrogen contents among various prices of green tea, Tea Research Journal **76**, 45-50 (1992)
6. K. Ito, Y. Nagato, N. Aoi, L. R. Juneja, M. Kim, T. Yamamoto and S. Sugimoto: Effects of L-theanine on the release of α -brain waves in human volunteers, Nippon Nogeikagaku Kaishi **72**, 153-157 (1998)
7. S. Matsumoto, Research of PMS, Bunkodo (1995)
8. R. York, E. Freeman, B. Lowery, Faan and J.F. Strauss, Characteristics of Premenstrual syndrome, Obstetrics & Gynecology, **73**, 601-605(1989)
9. Moos.,R.H.: The development of a menstrual distress questionnaire, Psychosom Med. **30**, 853-867 (1968).

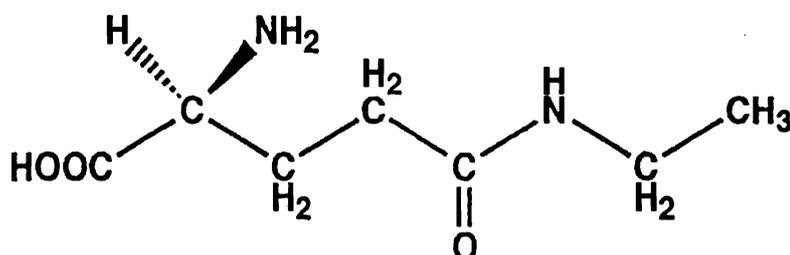


Figure 1. Structure of L-Theanine

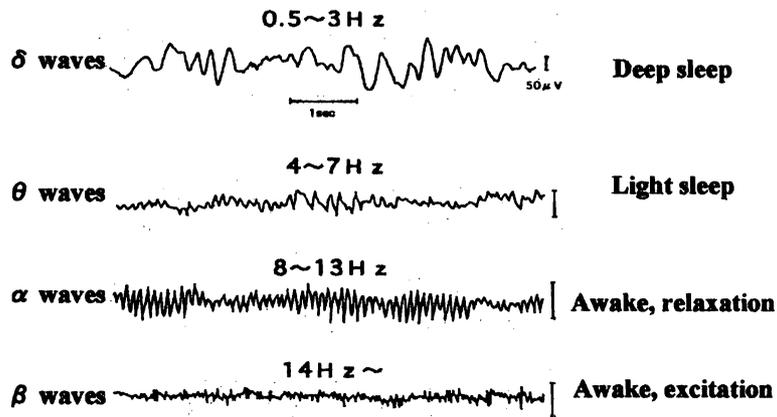


Figure 2. Classification of Brain Waves and Mental Condition

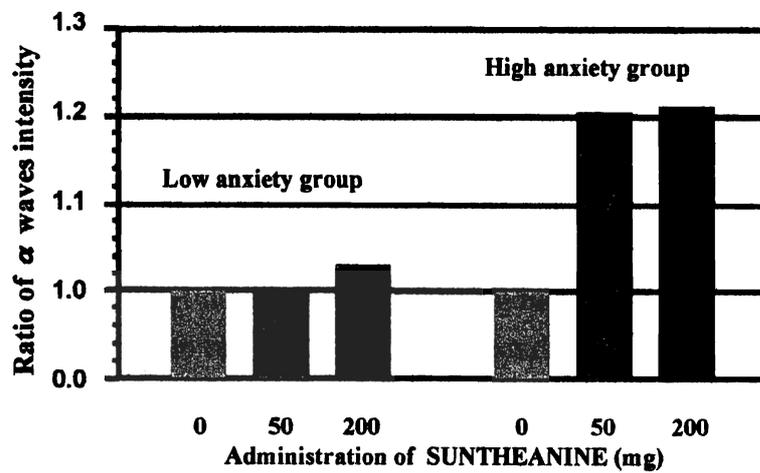


Figure 3. Effect of SUNTHEANINE on Emission of α -waves Based on Anxiety

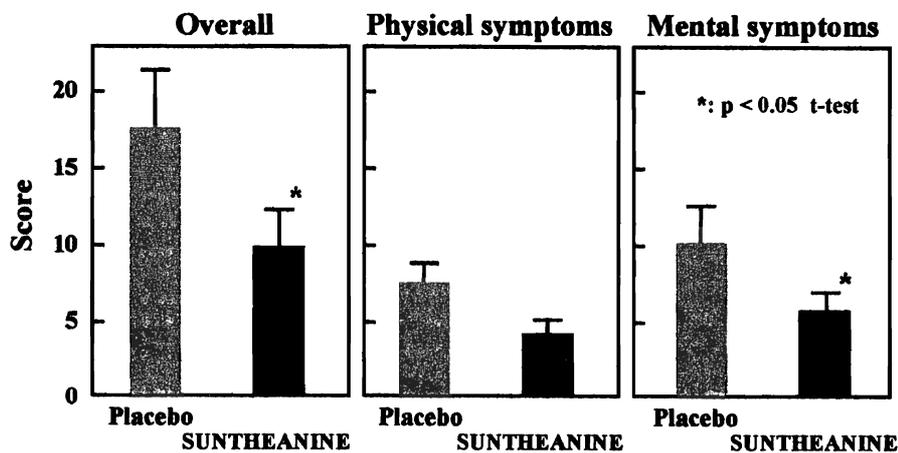


Figure 4. Effect of SUNTHEANINE on PMS