

# The Anti-Stress Effects of Lemon Essential Oil

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In our previous research, we have reported some functions of lemon essential Oil, however, most of our reports are based on an acute administration. In this study, mainly the sub-chronic effects of *s*-limonene were researched. And three dosages were investigated. It was found that the one-week administration of *s*-limonene would decrease the concentration of glutamic acid and tyrosine, and meanwhile, the concentration of  $\gamma$ -aminobutyric acid (GABA) would be increased significantly with dose-dependency. Besides these, the neurochemical analysis results demonstrated that, for dopaminergic system, the concentration of dopamine (DA) did not change a lot, but the dihydroxyphenylacetic acid (DOPAC) concentration increased significantly in most of the brain districts we discussed. Therefore, it means that the one-week administration of *s*-limonene might enhance the activity of dopaminergic neuron system through enhancing the synthesis and metabolism ratio of DA. However, there is no significant change of serotonergic neuron system except that in the hypothalamus, the concentration of serotonin (5-HT) decreased significantly.

Based on these results, the possible anti-stress effect was investigated. It was found this treatment antagonized the response of rats to the foot-shock stress significantly. And these effects were considered to be co-related with the enhanced GABA concentration. The reversed effects, after the administration of flumazenil, a type of GABA<sub>A</sub> receptor BZP site antagonist, confirmed our suggestion.

For drawing a more detailed graph about stress response, brain slice soaked method was used to gather the information of neurotransmission just after the stress exposure. The results suggested that, under foot-shock stress, the 5-HT release might be inhibited significantly and the recovery speed was also very slow. However this phenomenon was not found in other brain regions. Corticosterone, used for simulating the stress condition, also did not influence of 5-HT release. Therefore, it was thought that this inhibition might be stressor dependent. And the administration of lemon essential oil reversed this stress response.