



## Pharmacological Mechanisms of Ginseng for Depression in Post COVID-19

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### DESCRIPTION

The novel coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus-2, is the worldwide panic and global health concern since December 2019. The most common symptoms of COVID-19 illness are fever, cough, and dyspnea. In the most severe cases, people with poor immunity may develop pneumonia and multiple organ failure, eventually leading to death. However, no specific drug or vaccine has yet been developed and the epidemic will not be brought under positive control in the short term. As per the studies, the onset of a sudden and immediately life-threatening illness could lead to posttraumatic stress disorder. Quarantine is necessary to manage the outbreak, and the experience of being quarantined can, in some cases, lead to long-term adverse mental health consequences. Furthermore, many other economic problems caused by epidemic, such as financial difficulties and loss of employment, undoubtedly increased public anxiety and depression. Based on these, it is of great significance to prevent the outbreak of depression after a global epidemic while improving the public immunity.

Panax ginseng Meyer, as a precious tonic Traditional Chinese Medicine (TCM), usually grows in cooler areas like Northeast China, Korea peninsula and Russia. It is known as the king of invigorating Qi and the Greek term "Panax", which means "cure of all diseases", implied its important position in the medical field. TCM theory emphasizes "Healthy Qi is stored inside, evil cannot invade". Healthy Qi is equivalent to what we now call immunity. Ginseng can regulate each type of immune cells, therefore maintaining homeostasis of the immune system and enhancing resistance to illness or microbial attacks. It is also found ginseng and salviae herbs play a role as immune activators and modulate immune responses during influenza virus infection. As recorded in the traditional Chinese work ginseng

has been used in the classic prescription to treat neurasthenia and other nervous system diseases. Ginsenosides, as the main pharmacologically active components of ginseng, have been found to exhibit as novel antidepressant agents. It can be seen that ginseng has a good effect on both immune-regulation and anti-depression. However, its anti-depression therapeutic mechanisms have not yet been clearly elucidated.

Network pharmacology has been introduced in recent years for exploring the molecular mechanisms of TCM. The key ideas of emerging network pharmacology and network biology shares much with the holistic philosophy of TCM, updating the research paradigm from the current "one target, one drug" mode to a new "network target, multi-components" mode. Through bridging the emerging network science and ancient TCM, we obtain novel methodologies and opportunities for discovering bioactive ingredients and biomarkers, potentially revealing mechanisms of action. Even though the anti-depression effects of ginseng have been reported, network pharmacology-based prediction of the bioactive components and target pathways has not been performed.

Past experience shows that mental health problems often occur in the public following a major epidemic situation. The study is carried out for estimation of active compounds and pharmacological mechanisms of ginseng to exert anti-depressant activity using network pharmacology. A total of 47 potential targets were identified, which were significantly enriched in the neuro active ligand-receptor interaction, serotonergic synapse and HIF-1 signaling pathway, indicating that the therapeutic effects of ginseng were produced by synergistic complex interactions among its chemical compounds and related targets. More importantly, frutinone A and kaempferol are key ingredients in ginseng with dual activities of immune-regulation and anti-depression.

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