Rapid Literature Review on Panax Ginseng and Its Role in Stress-Induced Immuno-Modulation

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***Abstract*—For many years, Panax ginseng has been used as a natural plant for health benefits. The main reason for using it is to be physically active, healthy, and less tired. In recent times, there is a growing interest in its potential to alleviate stress. The immune system of an individual can become weak due to stress, whether it be from internal or external sources. Due to this they feel more easily ill and depressed.**

It is supposed that Panax ginseng can enhance the immune system's function, particularly during times of stress. This is known as stress induced immunomodulation. This review will primarily focus on how ginseng may assist the immune system in managing stressful conditions. It focuses on the important natural composites set up in ginseng, especially ginsenosides, and how they may help the body recover from the goods of stress.

Some studies suggest that ginseng can lower body swelling, keep stress hormones levels balanced in the body, and give energy when a person feels tired and stressed. At the end we expect we get idea about how Panax ginseng act and shows its effect in immune system strengthening. Although more research is still needed, this review helps explain how ginseng might be useful in managing stress related immune problems.

***Index Terms*—Panax Ginsen, Adaptogen, Stress, Immunomodulation, Ginsenoside,**

1. INTRODUCTION

Panax ginseng is a well-known medicinal plant, highly regarded in traditional East Asian practices, particularly in Korea and China, for its therapeutic properties. The word Panax comes from Greek and means 'cure-all,' showing that the plant is believed to have many health benefits. Its roots contain active compounds called ginsenosides, which are considered the major contributors to its effects, such as enhancing physical endurance, supporting cognitive function, and strengthening immunity.

Fig: Panax Ginseng

1.1. Panax Ginseng – A Traditional Medicine

This plant grows in Korea, China, and Russia, and people have relied on it in traditional medicine for thousands of years. In earlier times, it was mainly used by kings and nobles and was seen as a sign of good health, energy, and longevity.

In the past, it was mostly taken as tea or powder and was believed to boost strength, focus, mood, immunity, and energy.

Its primary bioactive constituents include ginsenosides, polysaccharides, peptides, essential oils, vitamins, and minerals, which together provide adaptogenic, antioxidant, and immune-modulating benefits.

1.2. Stress and Its Types

Stress is the body's natural reaction to challenges or demands, which can sometimes motivate performance but becomes damaging when it persists for long periods.

Acute stress is short-term, producing quick physical symptoms like rapid heartbeat or anxiety, and usually subsides once the challenge passes.

Chronic stress is long-lasting, often caused by unresolved issues, keeping the body in a state of alert. Prolonged elevation of stress hormones such as cortisol impairs immunity, contributing to high blood pressure, poor sleep, mood disturbances, and cardiovascular risks.

1.3. Overview of the Human Immune System
Protection from pathogens is achieved through the immune system, which functions via two complementary arms: innate defense and adaptive responses.
Innate immunity, present from birth, acts as the first line of defense, offering rapid but non-specific protection without memory.
Adaptive immunity develops over time, responds more slowly but with specificity, and retains memory of previous invaders.
Both systems work in coordination, with the innate system reacting immediately and the adaptive system providing targeted attack and long-term protection.

2. ADAPTOGENS

Adaptogens are natural substances in herbs that help the body adjust to physical, emotional, or environmental stress. Unlike single-target drugs, they gently regulate by balancing cortisol, supporting energy, protecting cells, and strengthening immunity.
Role in Maintaining Balance During Stress

- Manage stress response
- Support energy and endurance
- Keep stability in body functions •
- Promote overall well-being

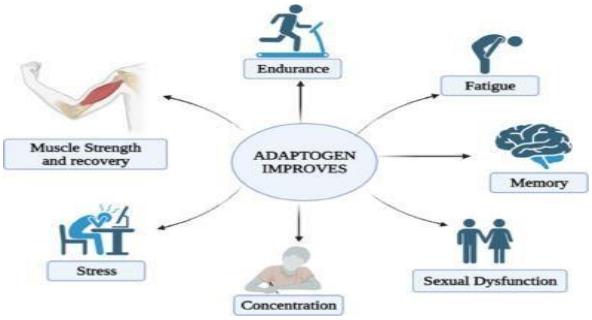

Fig: Benefits of Adaptogen 2.1. Panax Ginseng as an Adaptogen

Panax ginseng is widely recognized as a powerful adaptogen. It helps regulate stress hormones while strengthening immune defense and maintaining nervous system balance.
2.2. Stress-Induced Immune Suppression
Persistent exposure to stress increases cortisol secretion, which disrupts the immune system by reducing the activity of defense cells. This leaves the body more vulnerable to infections and long-term diseases.
2.3. Impact of Chronic Stress
Chronic stress gradually impairs immune competence. Elevate cortisol dampens immune responsiveness, white blood cells decline in number and efficiency, antibody generation weakens, uncontrolled inflammation rises, and tissue repair slows. Individuals under prolonged stress become more prone to infections, fatigue, and chronic health complications.
2.4. Role of Panax Ginseng in Immune Support
Research shows that Panax ginseng may counteract these adverse effects by improving white blood cell function, enhancing antibody production, and normalizing stress-related immune alterations.
2.5. Mechanism of Action of Adaptogens

Stress Stimulus
↓
Activation of HPA Axis & Sympathetic Nervous System
↓
↑ Cortisol & ↑ Adrenaline
↓
Imbalance in body systems
(Weakened immunity, oxidative stress, tiredness)
↓
Adaptogens Action
↓
1. Regulate HPA Axis → Stabilize cortisol
2. Balance Nervous System → Prevent overdrive
3. Support Immune Function → Optimize defense
4. Protect Cells → Antioxidant & energy boost
5. Aid Brain Function → Neuroprotection
6. Fight Fatigue → Improve recovery
↓
Homeostasis Restored → Resilient & Stable State

Flowchart: Mechanism of Adaptogens in Restoring Homeostasis

3. ACTIVE CONSTITUENTS OF PANAX GINSENG

Panax ginseng contains several natural compounds responsible for its health and stress-relieving effects.
The most important are ginsenosides, more than 30 types such as Rb1, Rg1, Rd, and Re, which influence the nervous, hormonal, and immune systems.
Other key constituents include:

1. Polysaccharides – boost immunity, reduce fatigue, and protect cells.
2. Peptides – support memory, learning, and cellular protection.
3. Polyacetylenes – show anti-inflammatory and antibacterial effects, with possible anticancer activity.
4. Vitamins and Minerals – B vitamins, vitamin C, and essential minerals that enhance overall health.

3.1. Main Compounds for Stress Control

Rb1 calms the brain, Rg1 improves stamina and alertness, Rd and Re protect nerve cells.

3.2. Mechanism of Stress Control

Ginsenosides regulate cortisol (HPA axis), balance neurotransmitters, enhance ATP production, and provide antioxidant defense.

Together, they maintain calmness, focus, energy, and protect body cells from stress-related damage.

4. PHARMACOLOGICAL ACTIONS OF GINSENG

Panax ginseng, rich in ginsenosides, shows multiple pharmacological actions that support health, energy, and stress resistance.

Its adaptogenic effect helps the body adjust to physical, mental, or environmental stress by balancing cortisol, improving stamina, and aiding recovery.

- Anti-inflammatory effect reduces tissue inflammation, protects organs, and calms overactive immunity.
- Antioxidant effect protects cells by neutralizing harmful free radicals.
- Neuroprotective actions include protecting brain cells from toxins or stress, supporting memory and mental clarity, and stabilizing mood via neurotransmitter balance.
- Immune-modulating actions include strengthening defenses against infections, boosting weak immunity, but calming overactivity.
- Anti-fatigue effect improves mitochondrial energy, reduces tiredness, and speeds recovery.
- Cardioprotective effect enhances circulation, reduces cardiac strain, and maintains healthy blood pressure.

Together, these actions explain ginseng's wide therapeutic benefits.

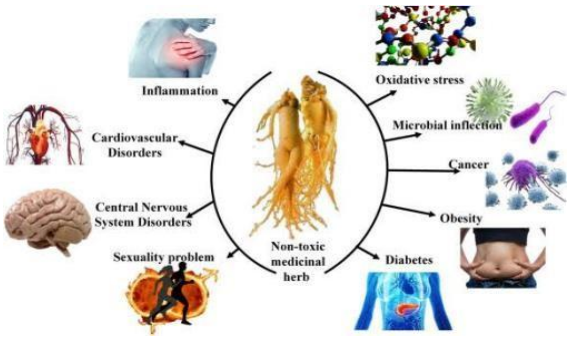

Fig. Beneficiary Actions of Panax Ginseng

5. GINSENG'S ROLE IN STRESS MANAGEMENT

- Ginseng has long been valued as a natural remedy to manage physical and mental stress. Its main active compounds, ginsenosides, act on the brain and hormonal systems to maintain balance.
- It regulates the HPA axis, ensuring cortisol levels rise when needed but normalize quickly, preventing long-term harmful effects.
- Ginseng helps regulate neurotransmitters such as serotonin, dopamine, and noradrenaline, which enhances mood, concentration, and resilience.
- Its antioxidant properties protect nerve cells from stress-induced oxidative damage.
- By enhancing ATP production, ginseng boosts recovery, reduces fatigue, and restores energy during prolonged stress.

5.1. Ginseng and Immunomodulation

Active Components

- Main bioactive compounds: Ginsenosides, polysaccharides, and phenolic Compounds.
- These compounds influence both the innate and adaptive immune systems.

5.2. Pathway of Ginseng in Immuno-modulation Process

Stress Condition

⬇

↑ Cortisol via HPA axis → Immune suppression

⬇

Ginseng intake → Ginsenosides & polysaccharides enter bloodstream

⬇

Modulation of Immune Mediators

↓ Pro-inflammatory cytokines (TNF-α, IL-6)

↑ Anti-inflammatory cytokine (IL-10)
⬇
Immune Cell Activation
↑ T-helper & cytotoxic T-cell function
↑ B-cell antibody production
↑ NK cell & macrophage activity
⬇
Outcome
Balanced immune response
Reduced inflammation
Improved pathogen defense under stress

Flowchart: Immuno-modulatory Pathway of Ginseng

6. PRECLINICAL STUDIES ON GINSENG IN STRESSINDUCED IMMUNE SUPPRESSION

Animal studies strongly show Panax ginseng has adaptogenic and immune-supportive properties under stress conditions.

- Forced Swim Test (FST) Models: Ginseng restored immune cell activity reduced by stress, improving splenic lymphocyte proliferation and NK cell activity.
- Restraint Stress Models: Supplementation reduced corticosterone, enhanced T-cell proliferation, and improved cytokine balance (↑ IL-2, ↓ IL-6).
- Cytokine Modulation: Normalized disrupted cytokines, maintaining balanced Th1/Th2 immunity.
- Antibody Production: Enhanced antibody formation, improving humoral immunity.
- Mechanistic Insight: Effects linked to ginsenosides regulating the HPA axis and limiting excessive glucocorticoid release.

7. CLINICAL EVIDENCE: GINSENG'S EFFECTS ON STRESS AND IMMUNITY

- Enhanced NK and Phagocyte Activity: In a double-blind study, purified ginseng polysaccharide (Y-75) boosted NK cell activity by 35–40% and phagocytic function by 25–39%. TNF-α rose by 38– 44% without side effects.
- Immune Activation: A placebo-controlled trial showed 2 g Korean Red Ginseng (KRG) increased T cells (CD3, CD4, CD8), B cells, and WBC count safely.
- Post-COVID Vaccination: KRG maintained stronger binding and neutralizing antibody levels.
- Exercise Stress: North American ginseng raised IL-2 but had minimal effects on other immune markers.
- Respiratory Illness: Mixed results; some trials showed reduced cold/flu incidence, others no effect.

8. SAFETY, DOSAGE, AND REGULATORY ASPECTS OF GINSENG

- Ginseng is generally safe in recommended doses but may cause mild headache, insomnia, or digestive upset.
- Excessive or prolonged use may cause elevated blood pressure and restlessness.
- Avoid in pregnancy, lactation, uncontrolled hypertension, or hormone-sensitive cancers.
- Usual dosage: 200–400 mg/day extract or 1–2 g root; best taken in cycles.
- Ginseng can interact with drugs like warfarin, antidiabetic medicines, stimulants, and certain herbs.
- Regulation: dietary supplement (US), traditional herbal medicine (Europe), AYUSH-regulated (India), and prescription or OTC in other regions.

Fig: Panax Ginseng Formulation

9. CONCLUSION

Panax ginseng demonstrates strong adaptogenic and immunomodulatory potential by restoring immune balance, regulating oxidative stress, and modulating the HPA axis. Ginsenosides play a key role in enhancing T-cell function, NK cell activity, and stress

resilience. Clinical findings suggest benefits in fatigue reduction, mental clarity, and immune strength, though variability in species, preparation, and dosage affects outcomes.

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