

Effects of *Radix Ginseng* on microbial infections: a narrative review

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Abstract

OBJECTIVE: To summarize the antimicrobial-like effects of *Radix Ginseng*, which provide important information to the relevant researchers and clinicians, and will benefit the clinical treatment of infectious diseases.

METHODS: PubMed and Google were used to search for and collect scientific publications related to *Radix Ginseng* and microbial infections. The authors read, classified, and discussed the associated scientific results or evidences, and summarized the corresponding results.

RESULTS: In this review, recent studies on the bene-

ficial effects of *Radix Ginseng* extracts on microbial and biofilm infections were reviewed. The importance and significance of *Radix Ginseng*'s beneficial effects are discussed. Evidence for the favorable effects of *Radix Ginseng* extracts on viral, bacterial, fungal, and parasitic infections and the possible underlying mechanisms are summarized.

CONCLUSION: *Radix Ginseng* might be a promising supplemental remedy for the prevention and treatment of infectious diseases.

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Key words: *Radix Ginseng*; Viruses; Bacteria; Fungi; Biofilms; Parasitology; Review

INTRODUCTION

Radix Ginseng is an ancient and famous Chinese herbal medicine, which has been used in China and northeastern Asian countries for more than 5000 years.¹ The first report describing the medical use of *Radix Ginseng* can be traced back to a Chinese book on materia medica, *Shen Nong Ben Cao Jing*, during Qin and Han Dynasties (221 BC-220 AD).¹ The classic text was published around 100 BC. in the West Han Dynasty and states that *Radix Ginseng* supports the five visceral organs, calms the nerves, tranquilizes the mind, stops convulsions, expunges evil spirits, clears the eyes, and improves memory.² The classic also says that *Radix Ginseng* helps to restore *Yin* and *Yang* and increase longevity.² Modern research has demonstrated that *Radix Ginseng* possessed important biological effects, which better explain its effects on some diseases or on body functions. *Radix Ginseng* can modulate functions of the central nervous system,³⁻⁶ cardiovascular system,^{5,7-9} endocrine system,^{5,6,10-12} immune system,^{5,6,13-19} improve metabolism, enhance body growth in children,^{2-4,7-9,20,21} ex-

hibit anticancer activity,^{5,6,22-24} protect against radiation,^{25,26} prevent aging,^{5,21} and prevent fatigue.^{5,27,28} Furthermore, *Radix Ginseng* has been investigated for its effects on infections. This review focuses on the development and progress in treatment of infections with *Radix Ginseng*.

RADIX GINSENG'S EFFECT ON VIRAL INFECTION

Viruses are one of the most common microbes that can result in human infections. The common viral infections include common cold, influenza, hepatitis, pneumonia, acquired immune deficiency syndrome, and diarrhea. Some viruses are not only highly infectious, but also difficult to control and sometimes life threatening. The development of antiviral measures is essential for the control of viral infections. Animal study has demonstrated that co-administration of 25 mg of inactivated influenza virus A PR8 and *Radix Ginseng* aqueous extract (200 mg/kg body weight) intranasally in mice twice (day 0 and 14) induced significantly higher levels of IgA antibody in the lungs and intestines, compared with the mice that received only inactivated virus.²⁹ In addition, at 15 days post-influenza A virus challenge, the splenocytes from the mice co-administered with *Radix Ginseng* and the inactivated influenza virus produced higher levels of T helper type 1 (Th1) and Th2 cytokines, especially interleukin (IL)-4 and IL-5 compared with those from the mice immunized with the inactivated virus alone.²⁹ Similar results were also obtained by other researchers using ginsenosides.³⁰ Yoo et al.³¹ found that *Radix Ginseng* acidic polysaccharide (12.5-50.0 mg/kg body weight) pretreatment, co-administration, and administration after lethal challenge with influenza H1N1 or H3N2 virus significantly enhanced survival rates and lowered viral titers in the lungs of mice. Yin et al.³² compared the *in vivo* anti-Influenza A H1N1 effects of *Radix Ginseng* polysaccharides, aqueous extract of whole *Radix Ginseng* Rubra, *Radix Ginseng* saponins, and PBS in the mice infected with 50% lethal dose of the virus, and found the respective survival rates were 78%, 67%, 56%, and 17%. Zhai et al.³³ reported that oral administration of *Radix Ginseng* stem-and-leaf saponins at 5 mg/kg 7 days before vaccination with live Newcastle disease vaccine in chicken induced significantly better systemic and mucosal immunity compared with those receiving *Radix Ginseng* after vaccination. In a multicenter, two-arm, randomized, placebo-controlled, double blind investigation, 227 volunteers received either placebo or 100 mg of *Radix Ginseng* standardized extract G115 orally once a day for 12 weeks. All volunteers received an anti-influenza polyvalent vaccination at week 4. There were 42 cases of influenza or common cold in the placebo group between week 4 and 12, but only 15 cases in the

Radix Ginseng group ($P < 0.05$).³⁴ Furthermore, antibody titers and natural killer activities in the *Radix Ginseng* group were significantly higher than those in the placebo group ($P < 0.05$).³⁴ In the controlled clinical trials involving 747 participants, taking *Radix Ginseng* preparations for 8-16 weeks reduced the total number of common colds by 25% compared with placebo, and *Radix Ginseng* shortened the duration of colds or other acute respiratory infection by 6.2 days.³⁵

Baek et al.³⁶ reported that *Radix Ginseng* pectic polysaccharides rescued cell viability from rotavirus infection dose-dependently. This was because the *Radix Ginseng* polysaccharides could inhibit rotavirus from attaching to the cells. Clinical studies demonstrated that *Radix Ginseng* treatment significantly slowed down the depletion of CD4 cells in human immunodeficiency virus (HIV) type-1 infected patients.³⁷ Combination treatment with antiretroviral therapy and *Radix Ginseng* significantly increased the CD4 numbers in blood and reduced the resistance mutations.³⁸ Panaxagin, a protein from *Radix Ginseng* displayed an inhibitory activity against HIV reverse transcriptase *in vitro*.³⁹ Canadian researchers found that a patented *Radix Ginseng* extract decreased the symptoms of viral infection in clinical trials. Further investigation demonstrated that *Radix Ginseng* extract induced the maturation of human monocyte-derived dendritic cells, which activated memory T-cells and stimulated the response of Th-1 cytokines.⁴⁰ In the vaccinations of porcine parvovirus and foot-and-mouth disease virus in mice, *Radix Ginseng* saponins induced better Th1 and Th2 immune responses against the viral infections, compared with those without *Radix Ginseng*.^{41,42} Lee et al.⁴³ reported that pretreatment with red *Radix Ginseng* extract and ginsenosides could significantly reduce the titer of hepatitis A virus in the FRhK-4 cell line compared with the controls, but the mechanism remains unknown. Cho et al.⁴⁴ found that pretreatment with red *Radix Ginseng* extract resulted in significant resistance to infection of herpes simplex virus in mice vagina from increased vaginal IFN-g and activation of NK cells.

Clearly, the administration of *Radix Ginseng* extracts (saponins, polysaccharides, aqueous extract, or proteins) has some interesting effects against viral infections by means of modulation of immune systems (Table 1). Immune responses can be divided into Th1 type (cellular immunity) and Th2 (humoral immunity). When a virus invades the human body, cooperation of both cellular immunity and humoral immunity is required for an effective defense response. Antibodies prevent the attachment and invasion of virus from mucosa and clear the free viruses from blood stream, whereas cellular immunity is required for clearance of the virus-infected cells. *Radix Ginseng* modulated both Th1 and Th2 immune responses, which might account for the anti-viral immune response.

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