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Therapeutic potential of *Ganoderma* species: Traditional medicine and evidence of effectiveness



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Numerous publications are stating that *Ganoderma* species have a variety of beneficial medicinal properties. Investigations on different metabolic regulations of *Ganoderma* species extracts or isolated compounds have been performed both *in vitro* and *in vivo*. However, it has frequently been questioned whether *Ganoderma* species including *Ganoderma lucidum* is simply a dietary supplement for health or just a useful "medication" for restorative purposes.

In Asian countries, *G. lucidum* (Lingzhi, Reishi) is a medicinal mushroom well-known to maintain good health and significantly contribute to longevity [1]. In Traditional Chinese Medicine (TCM), cultivated *G. lucidum* is used in numerous forms and pharmaceutical preparations to treat many pathologies and diseases, i.e., asthma, cancer, metabolic syndrome, myopathy... [2].

Different clinical trials are reported to verify the potential efficacy of this medicinal mushroom on type 2 diabetes mellitus (multiple-blinded randomized placebo-controlled), coronary heart disease (placebo-controlled double-blind, randomized; multicentered study), various cancer and immune response (meta-analysis of randomized controlled trials) [3-8].

The broad spectrum of the biological activities from *G. lucidum*, i.e., anticancer, antidiabetic, antioxidant is based on its chemical composition diversity [2, 9]. Antitumoral activity was attributed to triterpenoid derivatives as ganoderic acids with cytotoxic effects on different tumoral cell lines [10] through various signaling pathways [11]. β -D-glucans were reported for anti-inflammatory and immunomodulatory activities [12].

Syndrome or pathology	Preparation, Dose and Duration	Type of clinical trial Participants	Results
Type 2 diabetes mellitus	- Sporophore extract + spores - 24 weeks	Multiple-blinded placebo-controlled 25/group	No clinically significant effect of <i>Ganoderma lucidum</i> [3]
Type 2 diabetes mellitus	- Polysaccharide fraction - 1.8 g thrice daily - 12 weeks	Placebo-controlled 75/group	Diminution of HbA1C, FPG (post-prandial plasma glucose) FPG (fasting blood glucose) [6]
Coronary heart disease	- Polysaccharide fraction - 1.8 g thrice daily - 12 weeks	Placebo-controlled, double-blind, multicentered study 80/group	More primary symptoms (chest pain, palpitation, angin pectoris, shortness of breath) in <i>Ganoderma</i> group. Decrease of abnormal ECG, blood pressure, serum cholesterol [7]
Palliative care in oral squamous cell carcinoma patients. Postoperative support	- Powder or extract - capsules (500 mg) or - dental paste (0.5% extract) or - drinking tea (0.2% extract) thrice daily - 90 days	Placebo-controlled (placebo capsules contained <i>Plantago psyllium</i>) 25/group	Increase of body weight and appetite, improvement of clinical parameters (Karnofsky performance score, visual analog scale of pain), increase the tolerability to radiochemotherapy [5]
Rheumatoid arthritis, patients taking antirheumatic drugs (hydroxychloroquine, sulfasalazine, methotrexate and leflunomide)	- <i>G. lucidum</i> aqueous extract 4 g + Plants aqueous extracts (Rhizoma atractylodis, Cotex phellodendri, Radix achyranthes Bidentatae); 2.4 g of each plant; 3 capsules twice daily - 24 weeks	Placebo-controlled double-blind, randomized 28/group	Analgesic effects of <i>G. lucidum</i> associated with plants extracts. No significant antioxidant, antiinflammatory or immunomodulating effects [8]
Evaluation of the clinical effects of <i>G. lucidum</i> on long-term survival, tumour response, host immune functions and quality of life in cancer patients	- Different preparations: spore powder, capsule, liquid extract, tablets... - Different administrations - Different durations	Meta-analysis of five randomized controlled trials 373 subjects (five trials) 29/group to 100/group	Synergistic potential with chemo/radiotherapy. Enhancing immunity in cancer patients (stimulation of T-lymphocyte proliferation, improvements of CD3, CD4 and CD8). No significant change in NK-cell activity. Improvement of quality of life. No side effects except nausea and insomnia [4]



Ganoderma lucidum
(Curtis) P. Karst.
Lingzhi (China), Reishi
(Japan)

Conclusion: The *Ganoderma* industry earns billions of euros via wild collections and cultivation, consumption as tea or alcoholic beverages and the use of nutraceuticals, with the industry offering thousands of products to the markets. Following the traditional uses of medicine, *G. lucidum* is marketed as Reishi or Lingzhi in dietary supplements. These medicinal mushrooms focus on a great deal of hope for the treatment of various pathologies. However, further clinical trials should be essential to demonstrate the real benefit of *Ganoderma* species [13] of which *G. lucidum* [14] on human health. Indeed, few clinical trials are available, most of them are in Chinese language and are not free of regional limitations (Chinese populations). The preparations of *G. lucidum* are very different from one study to the next (extract or powder, sometimes associated with plants) and are often imprecise. *G. lucidum* is a first-line therapeutic mushroom.

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