

## Phytochemical, Antimicrobial Analysis and wound Healing Activities of *Ganoderma Lucidium*

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**Abstract:** *Ganoderma lucidium* mushrooms are an important natural source of foods and medicines. Mushrooms represent a major and untapped source of potent new pharmaceutical products. Traditional aboriginals knew the medicinal importance of edible and wild mushrooms and these are now being screened for their bioactivity in various ailments. The effect of *Ganoderma lucidium* extract on cancer, hypertension, hypercholesterolemia, hepatitis, wound healing and antimicrobial activities have been reported by many researchers. The undesired side effects of antibiotics and antimicrobial and the appearance of resistant and mutant strains make the development of new agents an urgent requirement. In developing countries like India mushroom progress is a boon in the field of food, medicine and in generating employment. The alternative systems of medicine utilize the curative properties of mushrooms. The present review is aimed to discuss phytochemical analysis, antimicrobial and wound healing activities of *Ganoderma lucidium*.

**Keywords:** *Ganoderma lucidium*, antimicrobial, phytochemical analysis, wound healing activity

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### I. Introduction

The Lingzhi or Reishi medicinal mushroom *Ganoderma lucidium* (W.Curt: Fr) P. Karst. (Ganodermataceae, higher Basidiomycetes) is one of the most popular medicinal species, with a long history in many countries (Wasser, 2010). It has been used as a home remedy in traditional Chinese medicine in Asian countries for over 2000 years because of its immunomodulatory and adaptogenic properties and for the treatment of chronic bronchitis (Ziegenbein *et al.*, 2006). It is also popularly accepted as a dietary supplement in Western countries (Adam *et al.*, 2003), (Boh *et al.*, 2007). The activities of *Ganoderma lucidium* are mainly due to polysaccharides or triterpenoids of the fungus. Some of the triterpenoids showed antioxidant, anticancer and antimicrobial properties (Prasad *et al.*, 2008, Quereshi *et al.*, 2010) found that extracts of *Ganoderma lucidium* from the exposed dead trunk and roots of *Magnifera indica* had antibacterial activity. *Ganoderma* species like any other fungi grow wild on living or dead or dying wood log of hardwood and sometimes on dead roots. Typically found at the base of living hardwoods or occasionally on the stumps or roots of a wide range of deciduous hosts (Chang and Mshigeni, 2001).

*Ganoderma lucidium* is known to metabolically produce active compounds such as polysaccharides, adenosine, alkaloids, mannitol, organic germanium, triterpenoids, and rare minerals (Shiao, 2003). These bioactive constituents of *Ganoderma lucidium* help to improve blood circulation, eliminate fatigue, enhance energy, strengthen the immune system, and discard toxins. During last three decades more than 150 triterpenes and more than 50 carcinostatic polysaccharides have been isolated and are known to be unique compounds in this mushroom (Kim, 2002). Mushroom nutraceutical components with potential therapeutic values are rich *Ganoderma lucidium*. The normal healing process can be impeded at any step along its path by a variety of factors. The process of wound healing is promoted by several natural and plant products, which are composed of bioactive constituents such as alkaloids, glycosides, flavonoids, and triterpenes. These agents usually influence one or more phases of the healing process (Singer, 1999). The *Ganoderma lucidium* also reported to have an anti inflammatory and liver protection effects in rat. Numerous authors have shown that triterpenes and polysaccharides are the major physiologically active components of *Ganoderma lucidium* (Zhou *et al.*, 2007).

### II. Phytochemical Screening

In this study done by (Kandhasamy Rajesh *et al.*, 2014) the extracts of the *Ganoderma lucidium* are rich in phytochemical constituents such as flavonoids, saponins, tannins, terpenoid and phlobatannin. Phytochemical screening from unprocessed *Ganoderma lucidium* reveals the presence of alkaloids, flavonoids, reducing sugars, tannins, cardiac glycosides, anthraquinones, saponins, volatile oil and steroids variation in the presence and concentrations of phytochemical were observed in the partitioned portion separated by methanol, Ethyl acetate and N-butanol (Shamaki *et al.*, 2012). This study showed that extract of *Ganoderma lucidium* do

not contain tannins, anthraquinones and volatile oils while other phytochemical were found in it (Olukayode, 2016).

Idowu *et al.*, 2003 studies shows that alkaloids in the *Ganoderma lucidium* mushroom powder explain its anti-bacterial activity. The carbohydrates high concentration significantly contributes antimicrobial activity of the mushroom (Ogbe *et al.*, 2008). In another study, the presence of tannins in both powdered and extract fractions of methanol and n-butanol can complex with the metal ions and macromolecules such as proteins and carbohydrates obtained in the powder sample can be utilized in weight reduction management (Dei *et al.*, 2007). Saponins are also reported to have anti-inflammatory, expectorant and immune stimulating effects (Ray Sahelian, 2012). Steroids are also precursors of Ganoderic acid and protease inhibitor (Ko *et al.*, 2008) who reported that steroids found from *Ganoderma lucidium* includes 0.3-0.4% has inflammatory activity. Triterpenoids are the bitter tasting phytochemical which gives the extract its bitter taste, the terpenoids are said to form complexes with steroids to provide the said anti-inflammatory effects of this wild mushroom and equally, its anti-bacterial property. The flavonoids, polyphenol in the study are known to be source of plant based antioxidants which can protect the nerves, heart, liver, and other organs and tissues. This antioxidant property (Sasikumar *et al.*, 2010) may be responsible for reduction of hepatic damage (Lakshmi *et al.*, 2006). The volatile oils(essential essentials) from *Ganoderma lucidium* has anti-bacterial and anti-viral properties reported by Carson *et al.*, 2006 and Edris *et al.*,2007 in *invitro* studies.

#### **Antimicrobial Activity of Ganoderma Lucidium**

In an *invitro* study a chloroform extract of *Ganoderma lucidium* was investigated for its antibacterial effect on Gram positive bacteria (*Bacillus subtilis*, *Staphylococcus aureus*, *Enterococcus faecalis*) and Gram negative bacteria (*E.coli*, *Pseudomonas aeruginosa*). Result showed that the extract had growth inhibitory effects on two of the gram positive bacteria with a minimal inhibitory concentration (MIC) of 8mg/ml for *Staphylococcus aureus* and *Bacillus subtilis* (Keypour *et al.*, 2008). In another invitro study, the direct antimicrobial effect of a *Ganoderma lucidium* water extract was examined against 15 species of bacteria alone and in combination with 4 kinds of antibiotics (yoon *et al.*, 1994). *Ganoderma lucidium* against *E.coli*, *Micrococous luteus*, *S.aureus*, *B.cerus*, *proteins vulgaris* and *salmonella typhi*, but less effective against other species tested. This study analysed the anti-bacterial effects crude organic and aqueous extracts of the mycochemical components of the indigenous *Ganoderma lucidium* mushroom using the agar disc diffusion method. The crude extracts of the *Ganoderma lucidium* mushroom exhibited various degrees of inhibition against the test organisms. The wide inhibitory zones were obtained with the crude benzene extract of *Ganoderma lucidium* against *E.coli* and *N.meningitides*. The lowest zone of inhibition was demonstrated with the aqueous extract against *E.coli*, the study has concluded that the crude extracts of the indigenous Namibian *Ganoderma* mushroom process antibacterial properties to all gram positive and gram negative strains tested (Shikongo *et al.*, 2013). The indigenous ganoderma mushroom has been used by locals in Namibia traditionally as a source of medicine to fight skin and wound infection and other ailments.

Mainly the activities of *Ganoderma lucidium* are due to polysaccharides or triterpenoids of the fungus. Triterpenoids from fungus showed antioxidant, anticancer and antimicrobial properties. It was found that *Ganoderma lucidium* was the most effective and strong antibacterial when tested against a panel of pathogenic and food contaminating bacteria by using filter paper disc diffusion the antibacterial activity of methanol, acetone and distilled water extract was found be more sound. Inhibitory effect of these extract against bacteria was also remarkable (Jayasingh *et al.*,2014).An interesting aspect of antimicrobial effect due to the extracts derived from this mushroom which contain bacteriolytic enzyme, lysozyme and acid protease(Klaus and Miomir, 2007).

#### **Wound Healing Activity of Ganoderma Lucidium**

In modern biomedical sciences searching and investigation of effective substances that promote wound healing are one of the developing trends. Today more than 70% of wound healing pharma products are based on plants, 20% on the mineral compounds and remaining containing of animal products as their base material (Kumarasamyraja, 2012). Some medicinal mushroom species belonging to Basidiomycetes are found useful in different wounds treating. The polysaccharides fraction as well as ethanol extract of *Ganoderma lucidium* fruiting bodies (Rony, 2011) and aqueous extract of *Hericium erinaceus* basidiocarp appeared the antiulcer effect in rats. *Agaricus blazei* polysaccharides has been found useful in burn wound contraction through rapid epithelization and collagenization (Sui, 2010). *Ganoderma lucidium* is one of the medicinal mushrooms with immense potential for therapeutic applications and Ganoderma species causes continuing interest of researchers including the study of the wound healing process (Lin, 2014, Gupta *et al.*, 2014). Wound healing occurs as a cellular response to injury and involves activation of keratinocytes, fibroblasts, endothelial cells, macrophages and platelets. Cytokines and growth factors released by these cell types are needed to coordinate and maintain healing (Brem, 2007). Mainly poor blood circulation and the oxygen supply in the affected could lead to

infection and gangrene formation (Brook, 2008). This physiological impairment that can result in a diabetic foot ulcer (DFU) further complicates the healing process.

To date reports of the applications of the medicinal properties of mushrooms in the healing of wounds in diabetic rats are rather rare (Kwon *et al.*, 2009) reported that the cauliflower mushroom, *Sparassis crispa* Wulf.Fr (Aphyllphoromycetidae) improved the healing of diabetic wounds. The *Ganoderma lucidium* extract showed significant enhanced healing activity, evidenced by an increase in wound contraction, collagen accumulation (hydroxyproline), hexosamine, and total protein content (Asheesh Gupta *et al.*, 2014). Basidiomycetes have been found to exhibit wound healing properties due to the presence of polysaccharides (Sui *et al.*, 2010), (Cheng *et al.*, 2013) the study of the effect of mushrooms on skin wound healing is important and actual (Tetiana *et al.*, 2015) Wound healing promoting effect of polysaccharides purified from *Tremella fuciformis* and *Auriporia auricular* fruiting bodies aqueous extracts has been demonstrated an *ex-vivo* porcine skin wound healing model (Khambre *et al.*, 2012). The effect of promoting skin wound healing has been established also for other species from genus *Ganoderma* (Amer *et al.*, 2013).

### III. Conclusion

*Ganoderma lucidium* is a well known Asian herbal remedy with a long and impressive range of application. Global consumption of *Ganoderma lucidium* is high, and a large, increasing series of patented and commercially available products that incorporate *Ganoderma lucidium* as an active ingredient are available as food supplement. The present study supported the usage of *Ganoderma lucidium* fruiting body as an ideal biopharmaceutics and suggests the solvent and aqueous extract could be used as a strong antimicrobial agent. All the extracts of *Ganoderma lucidium* might contain rich phytochemical constituents such as Glycoside, flavonoids, saponins, tannins, terpenoid, steroids, steroid, carbohydrates and phlobatannin and also the topical application of *Ganoderma lucidium* fruiting bodies powder aqueous extracts possesses wound healing activity.

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