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Ganoderma lucidum: Persuasive biologically active constituents and their health endorsement

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ABSTRACT

Ganoderma lucidum comprises probably 400 different biologically active constituents principally polysaccharides, triterpenoids, proteins, enzymes, steroids, sterols, nucleotides, fatty acids, vitamins and minerals which have been proved to have several therapeutical properties to control various diseases. Broad spectrum of its pharmacological actions have been established which include immunomodulation, anticancer, antidiabetic, antioxidant, antiatherosclerotic, antifibrotic, chemopreventive, antitumor, anticancer drug toxicity prevention, analgesic, anti inflammatory, antinociceptive, antimicrobial, hypolipidemic, hepatoprotective, antiandrogenic, antiangiogenic, antiherpetic, antiarthritic, antiosteoporotic, antiaging, antiulcer properties and estrogenic activity. The present review is an effort to investigate and compile the reported biologically active compounds, pharmacological activity, toxicity and comparative study of different medicinal mushrooms.

Abbreviation

P polysaccharide, P1 protein, 1 ganoderic acid C1, H, G, α and β, 2 ganoderic acid A, B, G, and H, 3 ganoderic acid Me, 4 ganoderic acid R, T, U, V, W, X and Y, 5 ganoderic acid B, D, F, H, K, S and Y, 6 ganoderic acid DM, A, C, F and G 7 ganoderic acid E, 8 ganoderic acid A, B, D, F, K and DM, 9 ganoderic acid F, 10 ganoderic acid A, S, Me, A-Mf and DM 11 ganoderic acid C and D 12 ganoderic acid B, C2 and G, 13 ganoderic acid Y, Me and Mf, 14 ganoderic acid Sz, 15 ganoderic acid T, 16 ganodermanontriol and 7-O-Ethyl ganoderic acid O, 17 ganoderic acid A, B, C, and D, 18 ganoderic acid R and S, 19 polysaccharides, 20 β-D-glucans, heteropolysaccharides and glycoproteins, 21 β-D-glucans 22 ganoderans B and D, 23 *G. lucidum* polysaccharide peptide (Gl-PP), 24 polysaccharides and polysaccharide-peptide complex, 25 acidic protein bound polysaccharides, 26 proteoglycan, 27 LZ-8, 28 neutral protein bound polysaccharide, ganodermin 29 lectins, 30 ganoderol B, 31 indigestible fibers,32 indigestible fiber β-glucans, 33 organic germanium, 34 nucleosides, 35 Oleic acid

Carbohydrates: βg β-glucan, Gβg glucurono β-glucan, Hβg hetero β-glucan, Xβg xylo manno β-glucan, Mβg manno β-glucan, G glucose, G1 galactose, M mannose, G2 glucoronic acids, X xylose, F fucose. R rhamnose, A arabinose.

Amino acids: A1 glycine, A2 alanine, A3 valine, A4 aspartic acid, A5 threonine, A6 serine, A7 proline, A8 glutamic acid, A9 methionine, A10 isoleucine, A11 histidine, A12 lysine, A13 arginine, A14 leucine, A15 tyrosine, A16 phenylalanine.

Enzymes: E1 carboxyl proteinase, E2 endopolygalacturonase, E3 endopectin methyltranseliminase, E4 cellulase, E5 1,4-β-D-glucan glucanohydrolase, E6 endo-and exo-polygalacturonase, E7 manganese superoxide dismutase, E8 carboxymethyl cellulose, E9 lignin-modifying enzymes, E10 laccase isozymes, E11 chymotrypsin inhibitors isoforms.

Complexes: GLPP Ganoderma lucidum polysaccharide peptide, GL glycoprotein, PBP protein bound polysaccharides, CG coumarin glycoside, LE lectin.

1. Introduction

Mushrooms are reproductive structures of certain fungi. It is expected that there are 1.5 million mushrooms species are distributed in the world among them 70,000 species are illustrated. Approximately 10,000 known speci es of mushrooms are distributed globally among them 2000 are safe for human health and about 300 of them have medicinal properties [1,2]. Medicinal mushrooms are affluent sources of pharmacological active compounds. *Ganoderma lucidum* (*G. lucidum*) exhibits a significant role in treatment and prevention of various diseases in several countries. It has been used in traditional Chinese and Japanese medicine as an herbal remedy for over 2000 years. [3–5]. As estimated by the World Health Organization, globally about three-quarters population depends upon traditional remedies for good health. *G. lucidum* is a good source of traditional medicine to provide a healthier life. Ahmad et al. reported aspect of safety and less adverse effect most of herbal drugs are migrating toward nutraceuticals and other

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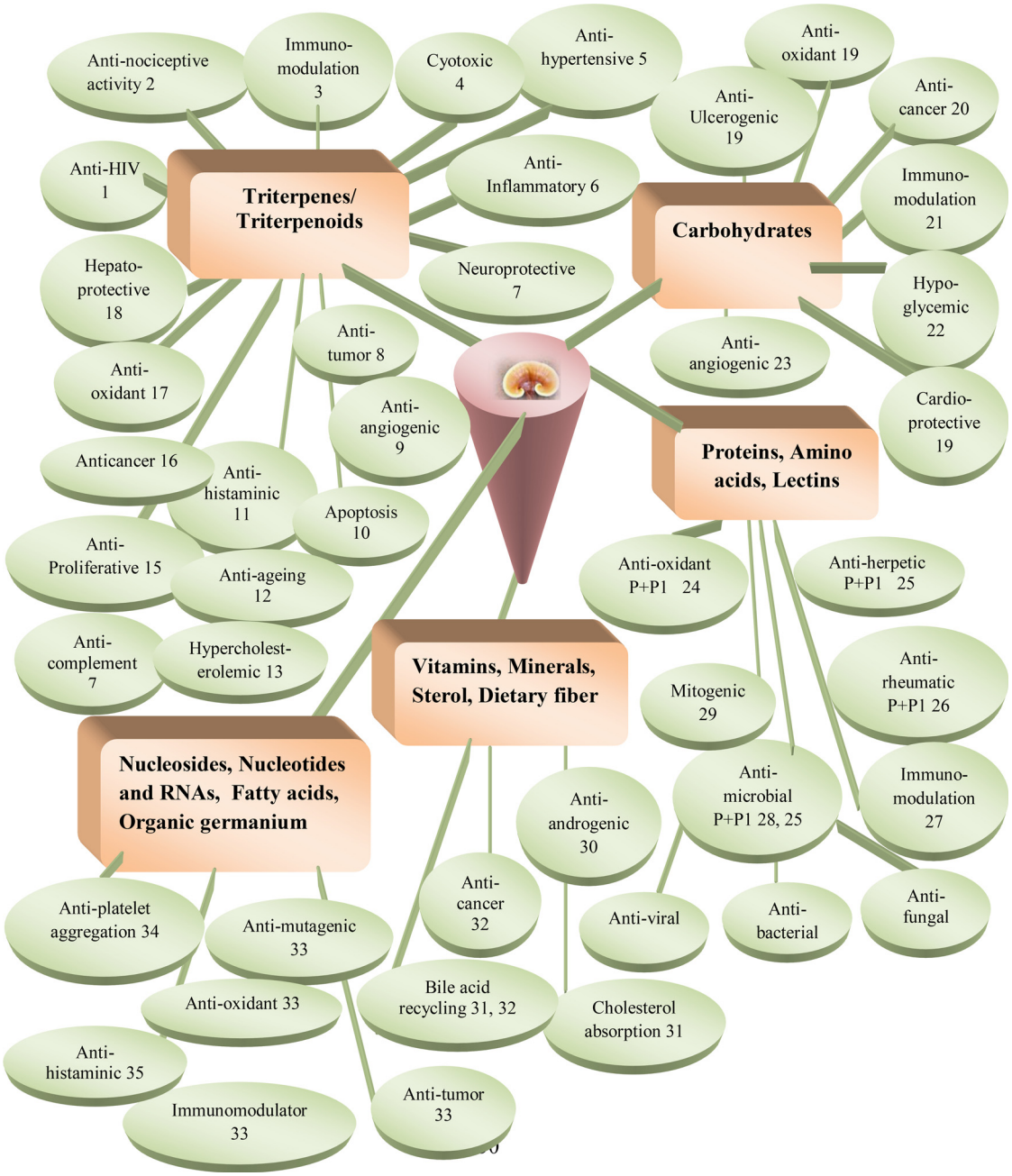

Fig. 1. Pharmacologically active compounds of *G. lucidum* and their pharmacological properties.

Table 1
Comparative medicinal properties of *G. lucidum* and other medicinal mushrooms.

Medicinal Mushrooms	*Ganoderma lucidum*	*Tremella fuciformis*	*Lentinula edodes*	*Grifola frondosa*	*Poria cocos*
Anti-tumor	Y	Y	Y	Y	Y
Anti-viral	Y	N	Y	N	Y
Immune enhancer	Y	Y	Y	Y	Y
Hypocholesterolemic	Y	Y	Y	N	N
Cardioprotective	Y	Y	Y	N	N
Anti-asthmic	Y	Y	N	N	N
Anti-depressant	Y	N	N	N	N
References	[14,16,181,182]	[183,184,185]	[186,187,188]	[189,190]	[30,191]

Y: favourable effect of medicinal mushrooms.
N: not known effect of medicinal mushrooms.