Review of: "In-Vitro Antibacterial Activity of some Ganoderma Species: A Review"

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Potential competing interests: No potential competing interests to declare.

Abstract

- Clearly highlight the review's objective from the outset to guide readers on what to expect.
- Present specific results from the mentioned preliminary research, providing concrete details instead of a general description to strengthen the review.
- Be clearer about the lack of evidence in humans regarding the antiviral and antibacterial properties of Ganoderma, explicitly highlighting the current evidence's limitations.
- Provide more specific details about the mentioned clinical results, explaining whether they support or contradict the antibacterial and antifungal properties of Ganoderma.
- Add a brief mention of future perspectives or areas of research to be explored to enhance the article's appeal, indicating possible directions for additional studies.

Diabetic Foot Ulcer

- Some sentences are lengthy and could be simplified for better clarity.
- Provide more specific references for statistics, such as the percentage of individuals with diabetes who will experience DFUs. Specific sources and recent data can enhance the credibility of the information.
- Be precise in language use, especially when discussing medical terms. For instance, instead of "difficult to cure," consider specifying the challenges associated with treating certain conditions related to DFUs.

Ganoderma and its species

- Briefly introduce the significance of Ganoderma and its species in medicinal mushrooms, explaining their popularity and importance.
- Structure the information more clearly by grouping details about Ganoderma's properties, various species, and their uses.
- Provide additional details on each Ganoderma species, including characteristics, traditional uses, and potential health benefits for a more comprehensive review.
- Condense the list of Ganoderma species or present them in a concise format, such as a table or grouped by regions for improved readability.
- Clarify the mechanism of action for compounds like polysaccharides, proteoglycans, proteins, and triterpenes,

explaining how they contribute to hypoglycemic activity.
- Clearly attribute findings to specific studies or sources, particularly when discussing Ganoderma's effects on blood glucose levels, to bolster the credibility of the information.
- Minimize information repetition, especially in the hypoglycemic activity section, ensuring that each statement adds new insights or builds upon existing information.

Antimicrobial activity

- Introduce Ganoderma's antimicrobial activity concisely, emphasizing its efficacy against fungi, viruses, and both gram-positive and gram-negative bacteria.
- State that medicinal plants, including Ganoderma if possible, are recognized by the World Health Organization (WHO) as valuable sources of natural antimicrobial substances.
- Highlight the antibacterial properties of Ganoderma species, specifically polysaccharides, triterpenes, and peptides. Specify their broad-spectrum antimicrobial activity against various bacterial strains, including those linked to diabetic foot ulcers.
- Clearly articulate Ganoderma extracts' ability to disrupt bacterial biofilms, especially in the context of chronic wound infections like diabetic foot ulcers.
- Streamline the section on bioactive metabolite extraction methods from Ganoderma. Focus on key methods in current research, offering a brief overview of their applications.
- Briefly describe applications of Ganoderma-derived nanoparticles, such as silver nanoparticles (AgNPs) and copper oxide nanoparticles (CuONPs), emphasizing their antibacterial properties and potential environmental benefits.
- Summarize findings from studies on AgNPs, CuONPs, and other Ganoderma-derived nanoparticles, emphasizing their antibacterial efficacy against specific strains.
- Condense information on environmentally friendly synthesis methods for nanoparticles, such as AgNPs and gold nanoparticles (AuNPs) using G. lucidum extract. Emphasize antibacterial activity observed in different bacterial strains.
- Summarize the creation and properties of zinc oxide nanoparticles (ZnO) with G. lucidum extract, noting potential applications and unique characteristics.
- Clearly state the importance of incorporating Ganoderma in anti-biofilm strategies, emphasizing its multifunctional properties, including antimicrobial, antioxidant, and immunomodulating capabilities.

Antimicrobial Activity of *Ganoderma* Species against Gram Positive Bacteria

- Emphasize fungi's suitability for nanoparticle synthesis due to enzyme and metabolite release, with a focus on recent interest in biomedical applications, particularly copper and copper oxide nanoparticles (CuONPs).
- Describe the production of micro quasi-spherical CuONPs from Ganoderma sessile, highlighting their effective antibacterial properties against Staphylococcus aureus (S. aureus) with an IC50 of 10.2 µg/mL.
- Showcase Ganoderma boninense mycelial extract's broad-spectrum antibacterial activity against S. aureus and S. pyogenes, underscoring the effectiveness of methanol-extracted GBMA.
- Highlight the bactericidal activity of Ganoderma sinense and Ganoderma multiplicatum extracts against S. aureus.

- Discuss G. lucidum culture fluids' ability to suppress both gram-positive and gram-negative plant pathogenic bacteria, including Rathayibacter tritici.
- Showcase the antibacterial properties of Mexican strains, including Ganoderma austral and Ganoderma lucidum, specifically against gram-positive S. aureus.
- Highlight the significant inhibition of Streptococcus pyogenes and Staphylococcus aureus (MRSA) by the hexane extract of Ganoderma lucidum.
- Discuss G. mbrekobenum's methanol extract, emphasizing its notable antibacterial activity against Bacillus cereus and Bacillus subtilis.
- Summarize the antibacterial activity of Ganoderma strains like G. tuberculosum, G. tornatum, and G. weberianum against Clavibacter michiganensis.
- Present findings from studies on ethanolic extracts of Ganoderma oerstedii, G. weberianum, and G. subincrustatum fruiting bodies, noting minimal antibacterial activity against S. aureus.
- Emphasize the strong antibacterial activities of AgNPs synthesized from Ganoderma applanatum against Escherichia coli and S. aureus.
- Discuss the significant antibacterial activity of zinc oxide nanoparticles synthesized from Ganoderma multipileum against gram-positive bacteria.
- Highlight G. boninense extract's susceptibility against methicillin-resistant Staphylococcus aureus (MRSA), causing irreversible damage to cell membranes.

Antimicrobial Activity of *Ganoderma* Species against Gram Negative Bacteria

- Emphasize CuONPs' antibacterial efficacy against Pseudomonas aeruginosa and Escherichia coli with IC50 values of 4.1 µg/mL and 8.5 µg/mL, respectively.
- Highlight G. boninense mycelial extract's antibacterial activity against E. coli, P. aeruginosa, and K. pneumonia.
- Discuss antibacterial properties of G. lucidum culture fluids against gram-negative plant pathogenic bacteria.
- Emphasize Ganoderma lucidum methanolic extract's higher antibacterial properties against E. coli compared to streptomycin.
- Highlight exceptional antibacterial efficacy of colloidal AgNPs from G. lucidum against gram-negative bacteria.
- Discuss antibacterial activity of G. lipiense extracts against Pseudomonas aeruginosa and Staphylococcus aureus.
- Highlight strong antifungal activity of G. mbrekobenum methanolic extract.
- Summarize experiments comparing antimicrobial properties of G. lucidum (GL) and G. neo-japonicum (GnJ) against specific pathogens.
- Discuss antibacterial potential of autochthonous Ganoderma species (G. resinaceum, G. pfeifferi, G. lucidum, G. applanatum) against specific bacteria.
- Highlight substantial antibacterial activity of zinc oxide nanoparticles from G. multipileum against gram-negative bacteria.
- Discuss in vitro antibacterial efficacy of AgNPs from G. sessile extracts against Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus aureus, emphasizing MIC values.

Conclusion

- Clearly state how Ganoderma species specifically accelerate wound healing in diabetic foot ulcers, reducing infection risks.
- Expand on Ganoderma's immunomodulatory effects, providing concrete examples and evidence of their impact on immune response, especially in diabetic individuals.
- Clearly specify the bacterial infections that Ganoderma species effectively combat, enhancing the conclusion's specificity.
- Provide a more detailed explanation of how Ganoderma's anti-inflammatory properties directly alleviate inflammation in diabetic foot ulcers.
- Acknowledge and address potential concerns related to natural remedies, enhancing the recommendation's credibility.

References

- Some studies may have already been surpassed by more recent research, and an updated literature review would be beneficial.