Ganoderma tsugae extracts inhibit colorectal cancer cell growth via G(2)/M cell cycle arrest

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摘要

Abstract

ETHNOPHARMACOLOGICAL RELEVANCE: Ganoderma, known as Lingzhi or Reishi, has been traditionally administered throughout Asia for centuries as a cancer treatment and for other medicinal purposes. AIM OF THE STUDY: To investigate the inhibitory activity and explore the molecular mechanisms of anti-tumor effect on colorectal cancer cells in vitro and in vivo as well as to test the side effects of Ganoderma tsugae. MATERIALS AND METHODS: Methanol fraction was obtained from dried fruiting bodies of Ganoderma. TLC and HPLC were performed to differentiate and confirm the identification of different species as well as to quantify the bioactive molecules in methanol extracts of Ganoderma species. MTT and Trypan blue exclusion assay as well as tumorigenesis study were used to assess the anti-tumor effect in vitro and in vivo. Using flow cytometry and Western Blots, we examined further the molecular mechanisms of anti-tumor effect. Finally, biochemical and hematological profiles and pathological examinations were used to evaluate the safety. RESULTS: The Ganoderma tsugae extracts inhibit colorectal cancer cell proliferation caused by accumulating cells in G(2)/M phase, and it may be through downregulation of cyclin A and B1 and upregulation of p21 and p27. Tumorigenesis study in nude mice revealed the extracts caused tumor shrinkage. Additionally, safety assay showed Ganoderma tsugae extracts caused no significant side effects in an animal model. CONCLUSIONS: This study provides molecular evidence that Ganoderma tsugae extracts exert anti-tumor effects both in vitro and in vivo on colorectal adenocarcinoma cells by inducing G(2)/M cell cycle arrest. More importantly, no significant physiological changes resulting from treatment with Ganoderma tsugae extracts were observed in the animal model. Therefore, these data provide new insights into the possible therapeutic use of Ganoderma tsugae for treating colorectal cancer