Enhancement of ganoderic acid by apoptosis-inducing drugs

藉由不同誘導凋亡藥物增加增加靈芝中靈芝酸產量

羅傑駿 (Jie-Jyun Luo)、 游邦照 (Bang-Jau You)

Department of Chinese Pharmaceutical Sciences and Chinese Medicine Resources,
College of Pharmacy, China Medical University, Taichung 40402, Taiwan

Introduction

Ganoderma lucidum, a popular traditional Chinese medicine, has been used for thousand years in Asia. Ganoderic acids (GAs), one of major biologically active components, shows pharmacological activities such as anti-oxidant, anti-tumor and anti-invasion. How to enhance GAs yield is an important issue. This study investigates whether the induction of apoptosis will promote GAs biosynthesis.

Materials & Methods

The drugs which induced apoptosis in mammalian cells, such as acetic acid (AA), sodium chloride (NaCl), zinc chloride ($ZnCl_2$), were used to treat the mycelia cell of *G. lucidum*. Mycelia cell were cultured on potato dextrose agar (PDA) for 7 days, and then transferred to the potato dextrose broth (PDB) with different dosage of drugs. After 2 and 4 days, fungal mycelia cell were collected, dried and extracted with methanol. The content of GA 24 and total GAs was analyzed by high performance liquid chromatography (HPLC). (Fig. 1)

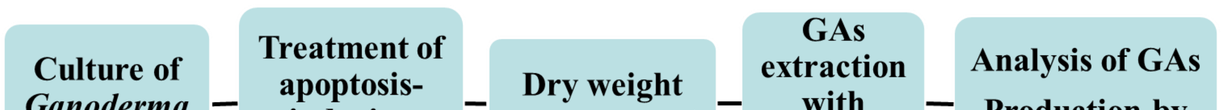

Figure 1. Experimental flowchart

Results

The results indicate that AA, NaCl and $ZnCl_2$ reduced biomass production significantly (Fig. 2) and led to a higher GA accumulation. The maximum induction of GA 24 were 1.86-fold (AA 160mM) and 1.48-fold ($ZnCl_2$ 2.7mM) in 2 days and 2.15-fold (NaCl 1M) in 4 days (Fig. 3). The maximum total GAs induction in were 1.79-fold (AA 40mM), 1.67-fold (NaCl 1M) and 2.97-fold ($ZnCl_2$ 5.4mM) after 4 days incubation, respectively (Fig. 4).

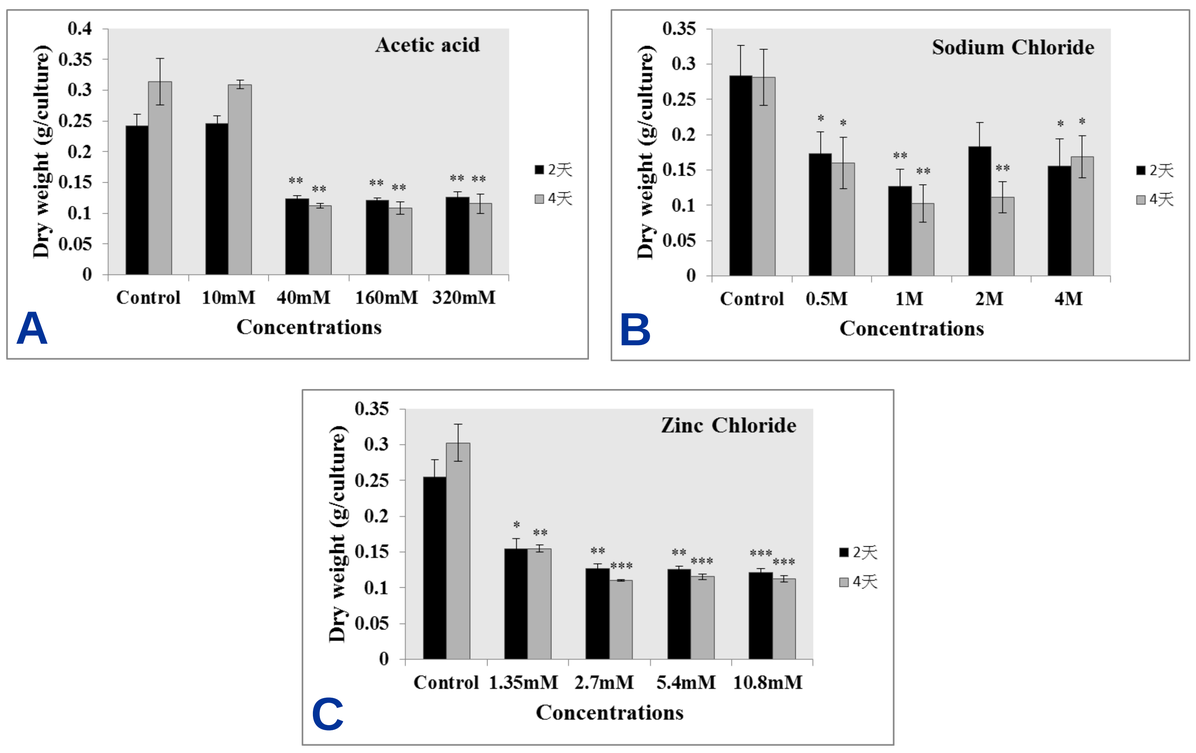

Figure 2. Effect of different drugs on fungal biomass.
Fungal mycelia were cultured on PDA for 7 days and then incubated with different drugs for 2 and 4 days. Acetic acid (A), sodium chloride (B) and zinc chloride (C) were used to treat mycelia. *p<0.05, **p<0.01, ***p<0.001 as compared with the control group.

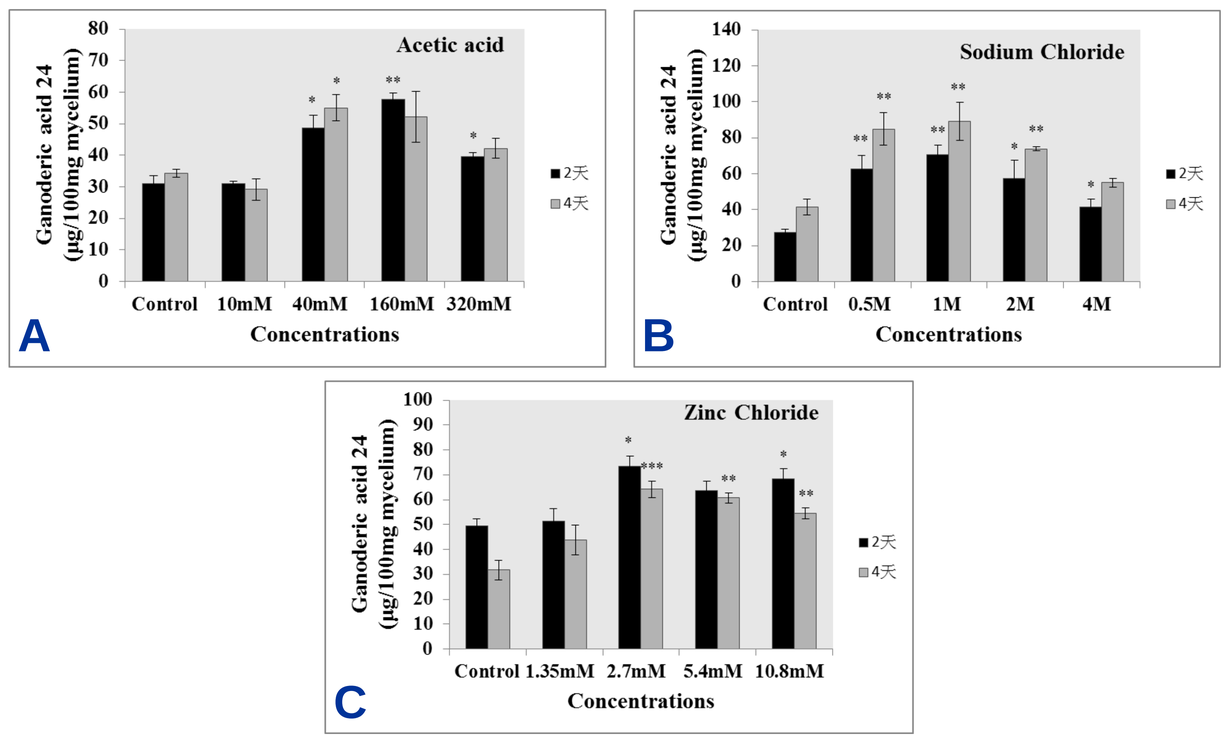

Figure 3. Effect of different concentration of drugs on the accumulation of ganoderic acid 24.
Fungal mycelia were cultured on PDA for 7 days and then incubated with different concentrations of drugs for 2 and 4 days. Acetic acid (A), sodium chloride (B) and zinc chloride (C) were used to treat mycelia. *p<0.05, **p<0.01, ***p<0.001 as compared with the control group.

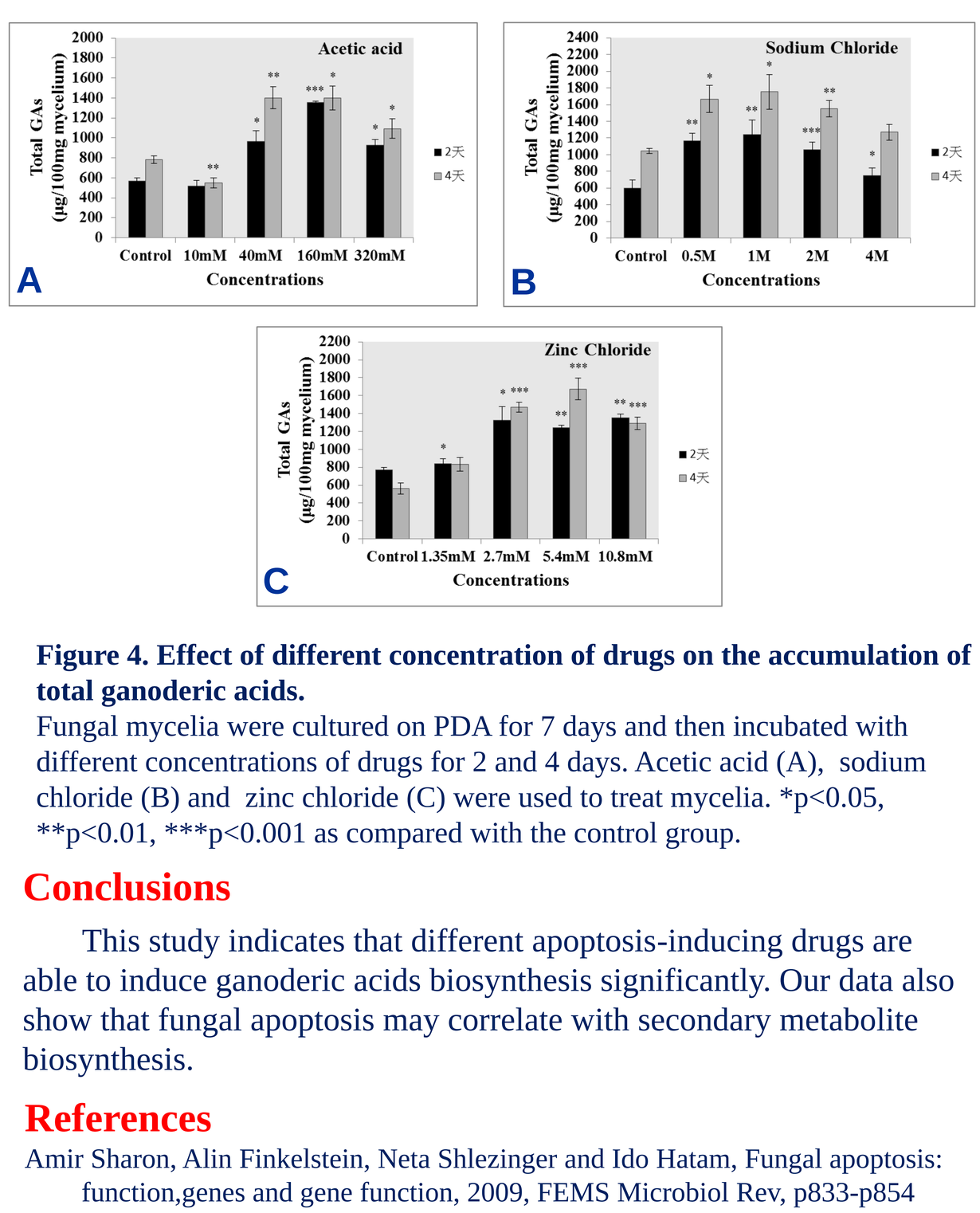

Figure 4. Effect of different concentration of drugs on the accumulation of total ganoderic acids.
Fungal mycelia were cultured on PDA for 7 days and then incubated with different concentrations of drugs for 2 and 4 days. Acetic acid (A), sodium chloride (B) and zinc chloride (C) were used to treat mycelia. *p<0.05, **p<0.01, ***p<0.001 as compared with the control group.

Conclusions

This study indicates that different apoptosis-inducing drugs are able to induce ganoderic acids biosynthesis significantly. Our data also show that fungal apoptosis may correlate with secondary metabolite biosynthesis.

References

Amir Sharon, Alin Finkelstein, Neta Shlezinger and Ido Hatam, Fungal apoptosis: function,genes and gene function, 2009, FEMS Microbiol Rev, p833-p854

Andrea Hamann, Diana Brust and Heinz D. Osiewacz, Apoptosis pathways in fungal growth, development and ageing, 2008, Trends Microbiol, p276-p283

Bang-Jau You, Miin-Huey Lee, Ni Tien, Meng-Shiou Lee, Hui-Chuan Hsieh, Lin-Hsien Tseng, Yu-Lin Chung and Hong-Zin Lee, A Novel Approach to Enhancing Ganoderic Acid Production by Ganoderma lucidum Using Apoptosis Induction, 2013, PLoS One