

## The nature of apoptosis of human breast cancer cells induced by three species of genus *Ganoderma* P. Karst. (Aphyllophoromycetidae) crude extracts

### ABSTRACT

The cytotoxic effect of crude extracts of three *Ganoderma* species (*G. lucidum*, *G. tropicum*, and *G. tsugae*) was screened against the human estrogen-independent cell line, MDA-MB-435 using a microculture tetrazolium (MTT) assay. The crude extract obtained from the fruiting body of *Ganoderma lucidum* by hot water extraction procedures had IC<sub>50</sub> values ranging from 140 to 350  $\mu$ g mL<sup>-1</sup>. Acridine-orange/propidium iodine staining, electron microscopy, and transmission electron microscopy showed that the crude extract caused both apoptosis and necrosis. The *G. lucidum* mycelial crude extract was most effective, with an IC<sub>50</sub> value of 148  $\mu$ g mL<sup>-1</sup>.

**Keyword:** Apoptosis; *Ganoderma*; IC<sub>50</sub>; Ling Zhi mushrooms; MDA-MB-435; Medicinal mushrooms; Mycelium; Necrosis