

PHARMACOGNOSIS

Effects of a High Molecular Mass *Convolvulus arvensis* Extract on Tumor Growth and Angiogenesis.

728

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Background. Plant materials represent promising sources of anti-cancer agents. We developed and tested a novel extract from the ubiquitous plant *Convolvulus arvensis*.

Materials and Methods. *Convolvulus arvensis* components were extracted in boiling water, and small molecules were removed by high-pressure filtration. The extract's biological activity was assessed by measuring its effects on S-180 fibrosarcoma growth in Kun Ming mice and on heparin-induced angiogenesis in chick embryos. We also examined the extract's effects on lymphocytes ex vivo and tumor cell growth in vitro.

Results. The extract (primarily proteins and polysaccharides) inhibited tumor growth in a dose-dependent fashion when administered orally. At the

highest dose tested, 200 mg/kg/day, tumor growth was inhibited by roughly seventy percent. Subcutaneous or intraperitoneal administration at 50 mg/kg/day also inhibited tumor growth by over seventy percent. The extract's acute LD₅₀ in Kun Ming mice was 500 mg/kg/day when injected, indicating that tumor growth inhibition occurred at non-toxic doses. It inhibited angiogenesis in chick embryos, improved lymphocyte survival ex vivo, and enhanced yeast phagocytosis, but did not kill tumor cells in culture.

Conclusion. High molecular mass extract deserves further study as an anti-cancer agent.

Key words: Angiogenesis, Experimental therapeutics, Tumors, Plant extracts

Plant materials may be promising sources of anti-cancer agents. Ingredients in medicinal plants such as mistletoe, tea, and the Chinese herb "Sho-Ssaiko-to" have been shown to induce programmed cell death in some cancer cells (1). Other plant extracts affect tumor angiogenesis and immune cell function. Angiogenesis inhibition is a particularly interesting therapeutic strategy because tumor vascularization is essential for tumor growth and metastasis (2). Angiogenesis inhibitors derived from natural sources include flavonoids, sulphated carbohydrates, or triterpenoids (3). Plant or plant products that stimulate immune cells in ways beneficial to the

treatment of cancer include garlic, mushroom proteoglycans, and various Chinese herbs (4-6). Non-toxic plant extracts containing angiogenesis inhibiting or immune stimulating ingredients may be promising anti-cancer agents, even if they do not show efficacy in screening assays based on in vitro tumor cell growth.

After receiving an anecdotal report concerning the complete remission of a human ovarian carcinoma in a patient who consumed a tea made from the ubiquitous plant *Convolvulus arvensis*, we became interested in testing the biological effects of *Convolvulus arvensis* extracts. *Convolvulus arvensis* is known to contain alkaloids, compounds that have anti-cancer activity but may also be toxic to the host at high doses (7). We concentrated our efforts on extracting high molecular mass, water-soluble molecules from *Convolvulus arvensis* in the hopes of producing an extract that was effective against tumors but lacked the toxicity of alkaloids. This manuscript details our production and characterization of such an extract. We tested the extract's effect on tumor growth in mice and, to learn more about its mechanism of action,

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