

Beneficial Effects of Mushrooms, Edible and Medicinal, on Health Care

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Studies on antitumor activities of Basidiomycetes have been ongoing at the National Cancer Center Research Institute of Japan since 1966. Today, studies on mushrooms are being carried out worldwide. At the time we started the studies, it had been said in Japan that solid mushrooms such as Polyporaceae (Sarunokoshikake in Japanese) were effective against cancer. We therefore tested solid mushrooms such as *Trametes versicolor* (L.: Fr.) Lloyd (kawaratake) and *Phellinus linteus* (Berk. et Curt.) Teng. (meshimakobu) by a bioassay to measure the so-called host-mediated antitumor activities, but the results were not always conclusive.

However, the aqueous extracts of edible mushrooms showed high growth inhibitory activity against solid Sarcoma 180. Antitumor polysaccharides such as glucans were isolated from the mushrooms, and among them, a β -(1-3)-glucan, which we isolated from *Lentinus edodes* (Berk.) Sing. (shiitake) was named lentinan and used in a narrow clinical adaptation in Japan.

Another popular edible mushroom, *Flammulina velutipes* (Curt.: Fr.) P. Karst. (enokotake), also has high antitumor activity, and polysaccharides and a low molecular weight protein-bound polysaccharide (EA6) were isolated. It was demonstrated that EA6 was active against tumors by oral administration (p.o.), although not so effective by intraperitoneal (i.p.) injection. It was shown to be especially useful by p.o. in combination with surgery and other antitumor agents. By

an antitumor screening test we isolated "pro-flamin" from mycelia of *F. velutipes*, which was highly active p.o. against allogeneic and syngeneic tumors in mice. An epidemiological study in Nagano Prefecture, Japan demonstrated that the cancer death rate among farmers producing *F. velutipes* as a main occupation was remarkably lower than that of other people in the Prefecture. A detailed epidemiological study is ongoing.

The cancer prevention effect of *Hypsizygus marmoreus* (Peck) Bigel. (bunashimeji), one of the most popular edible mushrooms, was investigated. It also has high antitumor activity and a preventive effect against tumor metastasis. A study of the cancer preventive effects of edible mushrooms was performed. The control mice were bred on an ordinary feed and the treated mice on a feed containing 5% of dried fruiting body of *H. marmoreus*. All mice were injected i.p. with a strong carcinogen, methylcholanthrene, and carcinogenesis of the mice was investigated. After the 76-week observation, 21 of 36 mice developed tumors in the control mice, but only 3 of 36 mice in the treated group had tumors. The cancer inhibitory and preventive activities of edible mushrooms were attributable to immunopotential and antioxidant activity. Thus, the intake of mushrooms proved to be effective in cancer prevention and growth inhibition. It has been said from ancient times in Oriental traditional medicine that medicine and food have the same origin (Ishoku Dougen or Yakushoku Dougen in Japanese).