

## Medicinal Mushrooms and Cancer

Donald I. Abrams, MD  
Chief, Hematology-Oncology  
San Francisco General Hospital  
Integrative Oncology  
UCSF Osher Center for Integrative Med  
Professor of Medicine, UCSF  
Vice-President, Society for Integrative  
Oncology

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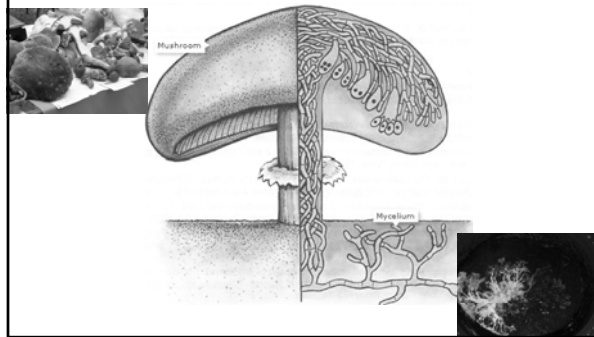
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## Mushroom Life Cycle



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## History of Medicinal Mushrooms

- Hot water decoctions from certain fungi long recognized to have health promoting effects, particularly in Eastern cultures
- ~ 300 species felt to have therapeutic potential, important in Asian cuisine and as folk medicines
- Crossover to West stimulated by:
  - Cancer epidemiology of *Flammulina velutipes* (enokitake) farmers
  - Isolation of specific active constituents
  - Superior organoleptic properties to dominant *Agaricus*
  - Multimillion \$ US market for edibles and medicinals

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### Anti-Cancer Activities

- Most mushrooms work as non-specific immuno-stimulants, enhance host response
- Activity may require intact T cell function
- Activity especially beneficial when used in conjunction with chemotherapy
- Some may have direct cytotoxic effects
- Most clinical trials and licensed drugs are in Asia; more studies needed

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### Trials of Mushrooms in Cancer: Issues in Design and Interpretation

- Information derived from:
  - *In vitro* effects
  - Animal models
  - Human trials
  - Epidemiologic observations
- Mushroom products studied:
  - Whole mushrooms: eaten, encapsulated or extracted
  - Mycelia or fruiting bodies
  - Extracts
    - Water: hot or cold
    - Ethanol
  - Isolated fractions

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### *Trametes versicolor*



- AKA *Coriolus*, *Polyporus*
- Turkey tail mushroom
- Yun Zhi (Cloud fungus)
- 2 proteoglycans
  - PSK (Krestin)
  - PSP
- Widely used adjuvant Rx in Japan and China
  - 25% of cancer care cost in Japan
  - Positive RCTs in GI (esp stomach) and breast

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### *Lentinus edodes*



- Shiitake
- Xiang gu (Fragrant mushroom)
- LEM
  - *Lentinus edodes* mycelium
- Lentinan
  - Cell wall constituent extracted from fruiting bodies or mycelium
  - Widely used as adjuvant immunotherapy in Japan
  - High MW precludes oral administration
- Active Hexose Correlated Compound base

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### *Grifola frondosa*



- Maitake
- Hen of the woods
- D-fraction
  - Found in mycelia and fb
  - Standardized  $\beta$ -1,3 and  $\beta$ -1,6 glucan fraction
  - MD-fraction is a more purified extract
  - Adaptogen and immunomodulator
  - May ↓ chemo side effects

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### *Ganoderma lucidum*



- Reishi
  - 10,000 year mushroom
- Ling Zhi
  - Mushroom of immortality
- Polysaccharides immune enhancing activity
- Ganoderic acid triterpenoids inhibit tumor cell growth
- Worldwide extract sales 1.5 billion annually

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### *Cordyceps sinensis*



- Used for vigor and stamina
- Lung and kidney tonic
- Restores immune activity with chemoRx
- Prolonged survival of mice receiving chemoRx
- May also improve anemia from chemoRx

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### *Hericium species*



- May stimulate brain derived nerve growth factor
  - Could be considered as a neuroprotective agent vs chemo-induced neuropathy
  - Possible use in chemo-induced cognitive impairment
  - Human studies needed!

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### *Agaricus species*



- *Agaricus blazei* most common CAM Rx in Japanese cancer patients
- *Agaricus bisporus* may have aromatase inhibitor activity
  - Significance of agaritine in raw button mushrooms unclear
  - ALL mushrooms must be cooked before eating !!!

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## Mushrooms and Green Tea

- Case control study in SE China 2004-2005
- 1009 women with confirmed breast CA and 1009 age-matched controls
  - Compared with non-consumers
    - OR- 0.36 (95% CI 0.25, 0.51) for daily intake >10g fresh mushrooms
    - OR- 0.53 (95% CI 0.38, 0.73) for daily intake > 4 g dried mushrooms
    - ORs 0.11 and 0.18 for fresh and dried in combo with >1.05 g dried green tea leaf beverages/day
  - Effects seen in pre and post-menopausal women

Zhang et al, Int J CA, 2009

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## Medicinal Mushrooms and Cancer

- Useful properties against cancer
  - Anti-neoplastic
  - Antioxidant
  - Immunomodulatory
  - Anti-inflammatory
  - Aromatase inhibition
  - Antiviral
- Symptom management potential

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## Unanswered Questions

- Which mushroom(s) to use for which cancer patient?
- When to prescribe in relation to chemoRx?
  - Chemo interaction doubtful though feared
- How long should/can they be taken?
  - TCM may suggest seasonal adjustments
  - Long-term safety and efficacy unclear
- Are they safe in immune-related cancers?

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