

## Medicinal Mushroom A Clinician's Overview

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## Mushrooms as Functional Foods

- Popularity high in Asia, just beginning in Europe
- North America—mushroom extracts sold without need of approval or registration
- Most popular: shiitake, maitake, reishi, cordyceps, turkey tails; *Agaricus blazei*, *Hypsizigus marmoreus*
- Products available: mushroom mycelium powder (grown on grain, soybeans), powdered extracts in capsules or tablets; ethanolic extracts (with or without glycerin)

## Health Benefits of Mushrooms

- Very little fat, no cholesterol
- Valuable mineral content; high trace minerals
- High in vitamins, especially B vitamins
- Pleurotus provides a better supply of B vitamins than any common food, except meat
- Great slimming food
- Cholesterol regulation! Shiitake, Pleurotus
- Very high in fiber—cellulose, lignan, chitin

## Mushroom as Food, Green Benefits

- Highly nutritious—oyster mushroom is 25% high-quality protein; vitamins, minerals
- Turkey Tails, *Trametes versicolor*, produces many enzymes used for detoxing toxic sites, biobleaching of paper, etc.



Table 2  
PROXIMATE COMPOSITION OF *PLEUROTUS* SPECIES

Species	Initial moisture	Crude protein (N × 4.38)	Fat	Carbo-hydrate	Fiber	Ash	Energy Value (kcal)	Ref.
<i>Pleurotus eous</i>	92.2	17.5	1.0	59.2	12.0	9.1	261	175
<i>P. florida</i>	91.5	18.9	1.7	58.0	11.5	9.3	265	175
<i>P. flabellatus</i>	91.0	21.6	1.8	57.4	11.9	10.7	271	19
<i>P. ostreatus</i>	73.7	10.5	1.6	81.8	7.5	6.1	367	18
<i>P. opuntia</i>	58.0	8.9	2.4	72.9	7.5	15.8	330	13
<i>P. limpidus</i>	93.0	38.7	9.4	46.6	27.6	5.3	313	13
<i>Agaricus bisporus*</i>	89.5	26.3	1.8	59.9	10.4	12.0	328	14
<i>Volvariella diplasia*</i>	90.4	28.5	2.6	57.4	17.4	11.5	304	15
<i>Lentinus edodes*</i>	90.0	17.5	8.0	67.5	8.0	7.0	387	16, 17

Note: All data presented as percentage of dry weight, except initial moisture.

\* For comparison.

Table 37  
ESSENTIAL AMINO ACID COMPOSITION\* OF *PLEUROTUS* SPECIES\*

Amino acids	<i>P. eous</i>	<i>P. florida</i>	<i>P. flabellatus</i>	<i>P. sajor-caja</i>	<i>P. ostreatus</i>	<i>Agaricus bisporus*</i>	<i>Volvariella diplasia*</i>	<i>Lentinus edodes*</i>	Hen's egg*
Leucine	8.5	7.5	6.2	7.0	6.8	7.5	5.0	7.9	8.8
Isoleucine	5.7	5.2	8.3	4.4	4.2	4.5	7.8	4.9	6.6
Valine	8.5	6.9	6.6	5.3	5.5	2.5	9.7	3.7	7.3
Tryptophan	1.4	1.1	1.3	1.2	1.3	2.0	1.5	nd	1.6
Lysine	11.1	9.9	7.5	5.7	4.3	9.1	6.1	4.3	6.4
Threonine	6.8	6.4	5.9	5.5	4.6	6.1	8.4	5.9	5.1
Phenylalanine	2.7	3.5	2.8	5.0	3.7	4.2	7.0	5.9	5.8
Tyrosine	2.7	2.7	2.8	6.3	3.0	3.8	2.2	3.9	4.2
Cystine	0.4	0.2	1.1	1.2	0.4	1.0	3.2	nd	2.4
Methionine	2.8	3.0	1.7	1.8	1.5	0.9	1.2	1.9	3.1
Arginine	4.4	3.2	9.5	6.2	5.3	12.1	9.3	7.9	6.5
Histidine	3.9	2.8	3.0	2.2	1.7	2.7	4.2	1.9	2.4
Total essential amino acids (excluding arginine and histidine)	50.6	46.4	44.2	43.4	35.5	41.6	50.1	38.4	51.3

Note: nd = not determined.

\* Data presented as grams of amino acids per 100 g of corrected crude protein.

\* For comparison.

Table 40  
ESTIMATED NUTRITIVE VALUE OF *PLEUROTUS* SPECIES<sup>a</sup>

Species	Essential amino acid index	Biological value	In vitro digestibility	Nutritional index	Protein score <sup>a</sup>
<i>Pleurotus eous</i>	95.7	92.7	89	16.7	59.7
<i>P. florida</i>	84.5	80.4	79	15.9	67.4
<i>P. flabellatus</i>	82.7	78.4	87	17.8	47.0
<i>P. sajor-caju</i>	70.9	59.2	63	14.4	67.6
<i>P. ostreatus</i>	64.8	58.9	nd	13.6	40.0
<i>Agaricus bisporus</i> <sup>b</sup>	55.8	49.1	nd	17.0	43.1
<i>Volvariella diplasia</i> <sup>b</sup>	87.9	84.1	nd	25.1	58.1
<i>Lentinus edodes</i> <sup>b</sup>	55.8	49.1	nd	9.8	nd

Note: nd = not determined; calculations based on amino acid analysis listed in Table 37.

<sup>a</sup> Using egg as reference protein.

<sup>b</sup> For comparison.

Table 42  
COMPARISON OF NUTRITIVE VALUE OF *PLEUROTUS* WITH VARIOUS FOODS

Essential amino acid index	Nutritional index	Protein score
100 — Pork, chicken, beef	59 — Chicken	100 — Pork
99 — Milk	43 — Beef	98 — Chicken, beef
91 — Potatoes, kidney beans	35 — Pork	91 — Milk
90 — <i>Pleurotus</i> (high)	31 — Soybeans	67 — <i>Pleurotus</i> (high)
88 — Corn	26 — Spinach	63 — Cabbage
86 — Cucumber	21 — Kidney beans	53 — Peanuts
79 — Peanuts	20 — Peanuts	50 — Corn
72 — Cabbage	17 — <i>Pleurotus</i> (high)	46 — Kidney beans
69 — Turnips	14 — Cucumbers	43 — <i>Pleurotus</i> (low)
67 — <i>Pleurotus</i> (low)	14 — <i>Pleurotus</i> (low)	33 — Turnips
53 — Carrots	11 — Corn	31 — Carrots
44 — Tomatoes	10 — Turnips	28 — Spinach
	9 — Potatoes	23 — Soybeans
	8 — Tomatoes	18 — Tomatoes
	6 — Carrots	

Table 60  
BIOLOGICAL CONVERSION EFFICIENCY AND PROTEIN YIELD BY DIFFERENT MUSHROOMS

Mushroom	Substrate	Biological conversion efficiency (kg yield ton <sup>-1</sup> dry substrate)	Protein content (% on dry weight)	Protein yield (kg ton <sup>-1</sup> dry substrate)	Ref.
<i>Pleurotus</i>	Rice straw	100	22.5	22.5	275
<i>Agaricus</i>	Compost	70	26.3	18.4	261
<i>Volvariella</i>	Straw	15	22.5	3.4	262
	Cotton waste	35		7.9	

## Mineral Content of Fungi

Species	Ca	P	K	Fe	Cd	Zn	Cu	Pb	Ref.
	mg per 100 g				ppm				
<i>Pleurotus eous</i>	23	1410	4570	90	0.4	82.7	17.8	1.5	6
<i>P. florida</i>	24	1850	4660	184	0.5	111.4	15.8	1.5	6
<i>P. flabellatus</i>	24	1550	3760	124	0.5	58.6	21.9	1.4	6
<i>P. sajor-caju</i>	20	760	3260	124	0.3	129.0	12.2	3.2	6
<i>P. ostreatus</i>	33	1348	3793	15.2	nd	nd	nd	nd	48
<i>Agaricus campestris</i> <sup>a</sup>	23	1429	4762	186	nd	nd	12.8	nd	14
<i>Volvariella diplasia</i> <sup>a</sup>	58	1042	3333	177	nd	nd	nd	nd	15
<i>Lentinus edodes</i> <sup>a</sup>	118	650	1246	30.0	nd	nd	nd	nd	13
Straw substrate <sup>b</sup>	87	1200	nd	172	0.4	20.7	21.9	2.5	6

Note: Data calculated on dry weight basis; nd = not determined.

<sup>a</sup> For comparison.

<sup>b</sup> Substrate used for the cultivation of *Pleurotus eous*, *P. florida*, *P. flabellatus*, *P. sajor-caju* consisted of chopped rice straw amended with 5% horse gram (*Dolichos biflorus*) powder on dry weight basis.

Table 29  
DIETARY FIBER (DF) CONTENTS IN FRUIT BODIES<sup>147</sup>

Species	% On dry weight basis		Total DF <sup>a</sup>
	Cellulose	Hemicellulose	
<i>P. cornucopiae</i>	17.6	24.5	46.0
<i>P. ostreatus</i>	11.6	27.8	47.5
<i>Tricholoma matsutake</i>	12.1	18.2	40.6
<i>Lentinus edodes</i>	12.0	22.2	37.5
<i>Agaricus bisporus</i>	11.1	13.0	29.9

<sup>a</sup> The total dietary fiber is the sum of neutral detergent fiber and pectic substances.

## Mushrooms as medicine

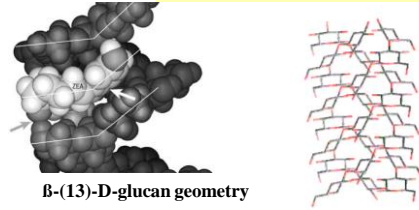
- Medicine—approved drugs in Japan, China for cancer treatment adjuvants (with chemo)
- Health supplements to support immunity



## Biological Activity of Fungi

- All fungi and yeasts have triple helix polysaccharides (beta-glucans) in cell walls
- Heat breaks down chitin, exposes active molecules
- Binding of large molecular weight fungal compounds to gut receptors (60% of total)
  - complex immune activation
  - Dectin, other receptors

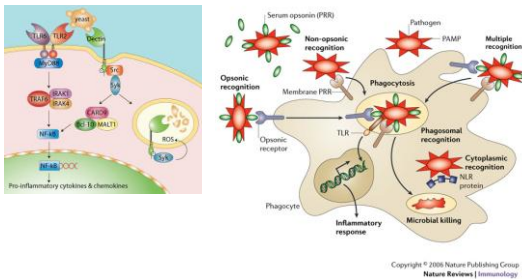
## Triple Helix of beta (1->3) glucan



$\beta$ -(13)-D-glucan geometry

- Triple helix conformation might give flexibility to cell wall
- Intact tertiary structure can confer increased immunomodulation
- Alcohol, excessive heating could disrupt tertiary structures

## Beta-glucans→Dectin Receptor



## Some Possible Indications

- Shiitake for immune weakness, infections
- Shiitake, Turkey Tails for Cancer
- Viral Syndromes: Hepatitis C, herpes, HIV
- Cordyceps for fatigue, performance, “adaptogen,” antiaging supplement
- Reishi for insomnia, anxiety, nervous system disorders related to stress
- Reishi for respiratory problems

## Research Summary

- More than 270 recognized species of mushrooms are known to have specific immunotherapeutic properties
- Fifty nontoxic mushrooms species yielded potential immunocuticals *in vitro*
- Six species have been studies in human cancers

J Society Integr Oncol. 2008 Summer; 6(3): 122–128

## Therapeutic Use—Questions!

- Mushroom products widely used, many countries
- Important questions
  - Whole mushrooms or isolated constituents?
  - Smaller pieces of heteroglucans active? Alcohol, heat, Hcl all reduce size of initial compounds
  - Fruit body, or mycelium more effective?
  - Fresh vs. dry
  - Dose--too high a dose can lead to immune suppression, not high enough, immune activation may be incomplete

## More Questions Clinical, Personal Use

- Common Questions
  - Substrate: host species varies for most polypores
  - Specific scope of indications?
  - Duration of treatment? Will immune activation decrease with time?
  - For cancer, more effective with radiation or chemotherapy? Or alone?
  - Integration into modern health care—controlled studies are needed

## Conclusion

- More controlled human clinical trials needed
- Mushroom extracts are effective for counteracting some harmful effects of chemo and radiation
- Counteract immune suppression
- Mushroom extracts can lead to increased survival times and improved quality of life
- Preliminary published research, as well as clinical reports show effectiveness for hepatitis C and other viral syndromes

## Traditional Chinese Medicine

- Historical medical use in Asia is often based on the precepts of traditional Chinese medicine (TCM)
- Mushroom species are often added to soups, traditional foods and eaten regularly for immune support, other healing qualities (over 3,000 years)
- Often added to prescriptions to treat “deficiency” or xu conditions of Kidney, Heart, Lung, Spleen systems

## Traditional Chinese Medicine II

- Most common species added to prescriptions include
  - Hoelen, fuling (*Wolfiporia cocos*)
    - Tonify Spleen system (digestion), remove excess water, counteract fatigue, improve immune status
  - Zhuling (*Grifola umbellatus*)
    - Diuretic herb, remove excess water (edema), cancer
  - Ling zhi (*Ganoderma lucidum*)
    - Calm “spirit,” for disturbed “shen,” respiratory ailments, panacea
  - Dong Chong Xia Cao (*Cordyceps sinensis*)
    - Exhaustion, sexual debility, to build “essence”

## Most Clinically-Relevant Medicinal Mushrooms

- |                              |                    |
|------------------------------|--------------------|
| • <i>Lentinus edodes</i>     | Shiitake           |
| • <i>Trametes versicolor</i> | Turkey tails       |
| • <i>Ganoderma lucidum</i>   | Reishi             |
| • <i>Grifola frondosa</i>    | Maitake            |
| • <i>Wolfiporia cocos</i>    | Hoelen, Fuling     |
| • <i>Pleurotus</i> spp.      | Oyster mushroom    |
| • <i>Cordyceps sinensis</i>  | dong chong xia cao |

• Other interesting species: *Agaricus blazei*, *Tremella fuciformis*, *Inonotus obliquus*, *Heiricium*???

## *Trametes versicolor* Turkey Tails



- Ubiquitous polypore on nearly every continent
- Delignifies many hardwoods, especially oaks; fruit trees
- Prescription drugs in Japan for treatment of cancer with purified protein-polysaccharide complexes (PSP, PSK)



### *Trametes versicolor* Turkey Tails

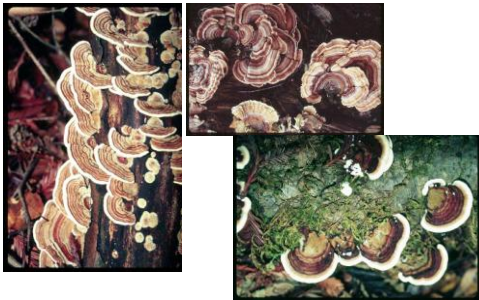


### *Stereum* spp. False Turkey-Tails

- Zoned, hairy cap
- Turkey tails: rough, white pore surface
- *Stereum*: smooth orange pore surface
- Grow in similar habitats on hardwoods



### *Trametes versicolor*



### Summary of *Trametes versicolor* cancer Clinical Trials Conducted in Asia

Type of Cancer	No. of RCT
Stomach	21-RCTs, $N = 13,498$
Colorectal	9 RCTs, $N = 2,194$
Esophageal	3 RCTs, $N = 532$
Breast	4 RCTs, $N = 2,217$

J Soc Integr Oncol. 2008 Summer; 6(3): 122–128.

### PSK, PSP

- PSK, PSP; crude extracts from *T. versicolor*
- prepared from strain CM-101 of *Tv* by water extraction
- 62% polysaccharide and 38% protein
- proteoglycan molecules bioavailable orally
- Bioactive molecules found in bone marrow, salivary gland, brain, liver, spleen, pancreas, and tumor tissue within 24 hours (*in vivo*)

### *Trametes versicolor* most-studied

- One medicinal mushroom, *Tv*, has been studied in phase I, II, and III randomized clinical trials
- Stomach, colorectal, esophageal, and breast cancer patients
- Japanese and Korean clinical data provide support for the hypothesis that immunomodulation can influence the clinical course in various cancers
- Meta-analysis in 1,094 colorectal cancer patients, all showing a positive impact on clinical outcomes (Sakamoto *et al*, 2006)

## Mushroom Research in U.S.

Bastyr University and University of Minnesota

2.4 million awarded for explore the feasibility for use of mushroom extracts as immunomodulating agents

### *Trametes Versicolor* in Women with Breast Cancer

- Phase II randomized-placebo controlled trial of a mushroom extract (*Trametes versicolor* or Tv)
- Women with early stage breast cancer who have completed adjuvant radiation therapy
- Immune recovery—enhanced natural killer cell activity, etc.
- Self-reported quality of life/ fatigue scores
- On-going research for Breast, Prostate Cancer re-funded, 2011

## *Trametes versicolor* mushroom immune therapy in breast cancer

- “Data from multiple epidemiologic and clinical studies .... suggest that immune function has a role in breast cancer prevention.”
- “Immune therapy utilizing the polysaccharide constituents of *Trametes versicolor* (Tv) as concurrent adjuvant cancer therapy may be warranted as part of a comprehensive cancer treatment and secondary prevention strategy.”
- J Soc Integr Oncol. 2008 Summer;6(3):122-8.

## *Trametes versicolor* Clinical Indications

- PSK:
  - Cervical, gastric cancers, carcinoma of nasopharynx
  - Glomerulonephritis, sarcoidosis, idiopathic nephrotic syndrome, lupus, chronic rheumatoid arthritis (Immune enhancement and improved clinical outcomes with such diseases)
  - Fewer outbreaks of genital herpes (increased cellular immunity)
  - Hyperlipidemia (reduced LDL levels in stage IIa)
- PSP:
  - Cancers of the esophagus, stomach, and lung (controlled, 3 g/day p.o.) with chemo- and radiation therapies: less side effects including anorexia, fatigue, pain; higher body weight; improved immune status.
  - Esophageal cancer: higher remissions with PSP and chemo (72% vs. 42% on chemo alone).

## *Trametes versicolor* Dose, Side Effects

- Dose: 3-6 grams/day orally; i.v. administration
- Toxicity low, few reported side effects, even with i.v. administration.
- Negative results were found on the Ames and chromosome distortion tests

## *Lentinus edodes* Shiitake

- Xiang gu or “fragrant mushrooms” of Chinese cuisine
- Second most widely cultivated mushroom
- Most published scientific studies



Fruiting body of shiitake on oak

## *Lentinus edodes*

- Biological Effects
  - Immunomodulating
  - Antitumor, anticarcinogenic
  - Antiviral
  - Hepatoprotective
  - Antiulcerogenic
  - Anticholesterolemic

## *Lentinus edodes* Clinical Trials

- Clinical trials summary
  - Numerous Chinese, Japanese clinical trials with LEM + chemo for various cancers
    - 5-year survival rate is up to 30% higher with LEM over placebo
  - Antitumor effect, increase survival time for patients with inoperable gastric cancer; with breast cancer (lentinan)
  - Best results seen in phase III trial when lentinan was administered

## *Lentinus edodes*

- Summary of indications
  - AIDS/HIV
  - Hepatitis C, B (chronic)
  - Cancer (prevention, treatment (often with chemo, radiaiton)
  - Hypercholesterolemia
  - Chronic fatigue, viral syndromes
  - Immune suppression
  - Infectious diseases



## *Ganoderma lucidum* Reishi, Ling Zhi (antler form)

- Ling zhi celebrated in ancient Chinese art
- Revered for several thousand years to treat liver disease, nervous system disorders, respiratory tract infections
- Modern research shows immunomodulating, anticancer effects



## *Ganoderma lucidum* Biological Effects

- Analgesic (antinociceptive)
- Antiallergic, antihistamine
- Antiinflammatory
- Antibacterial
- Antioxidant
- Antitumor, antimutagenic
- Antiviral (HIV, others)
- Antihypertensive
- Immunostimulating
  - Enhances bone marrow nucleated cell proliferation
  - Enhanced NK cell activity
  - Interleukin-1, -2 production
  - Increase in WBC production
- Cardi tonic
- Antithrombotic (*G. japonicum*)
- Central depressant, peripheral anticholinergic
- Expectorant, antitussive
- Adrenocortical functions
- Hepatoprotective
- Protection against ionizing radiation
- Antiulcer

## *Ganoderma lucidum* Traditional Indications, Dose

- Calms the spirit, augments the Heart qi, and tonifies the Heart blood: for insomnia, fright and palpitations, and forgetfulness associated with insufficient Heart qi and blood
- Failing to nourish the spirit. Can be used as a stand-alone herb for this purpose
- Deficiency consumption, cough, wheezing, insomnia, and poor digestion
- Bensky et al (3<sup>rd</sup> edition, 2004)

## *Ganoderma applanatum* Artist's Conk

- Common worldwide on hardwoods
- Pore surface turns brown when scratched
- Hepatoprotective effect in patients with post-hepatitis cirrhosis or chronic hepatitis B





## *Ganoderma lucidum* Traditional Indications, Dose

- **PROPERTIES** sweet, neutral
- **CHANNELS ENTERED** Heart, Liver, Lung
- **KEY CHARACTERISTICS** calms the spirit while augmenting the qi and nourishing the blood
- **DOSAGE** 3- 15g in decoctions; 1.5-3g in pills and powders
- **CAUTIONS & CONTRAINDICATIONS** Use with caution in patients with excessive conditions.

According to Bensky et al,

## *Ganoderma lucidum* Clinical Indications

- Anti-aging, antioxidant effect
- Adjuvant for cancer treatment protocols
- Nervous system disorders: neurasthenia, dizziness, insomnia (deficiency types--spirit or "shen" disturbance)
- Mental diseases, alzheimer's disease
- Rhinitis, bronchitis, other chronic URIs; respiratory allergies
- Duodenal ulcers
- Hyperlipidemia
- Diabetes
- Hepatitis

**Therapeutic Dose:** 3-12 grams fruiting body powder; 3-5 g powdered extract

## *Ganoderma applanatum*

- **Clinical indications**
  - Urinary, respiratory tract infections
  - Tuberculosis
  - Esophageal cancer
  - Post-hepatic cirrhosis
  - Chronic active hepatitis
- **Biological effects:**
  - Immunostimulating
  - Antitumor activity against sarcoma 180, other tumors in mice
  - Substance with interferon-like properties induced from mouse spleen cells

## *Ganoderma sinense*

- Traditionally used to treat deafness, afflictions of the joints, and to strengthen the "shen," or spirit
- "Improves the complexion, increase agility, and imparts longevity"
- Antiinflammatory, diuretic, and to improve stomach function
- Analgesic and antiinflammatory activity in arthritis models in mice
- Mycelial extract promotes phagocytosis



## *Ganoderma tsugae*

- Fruiting bodies grow on old hemlocks
- Song shan ling zhi (pine tree fungus)
- Widely-cultivated in Taiwan



## *Ganoderma tsugae*

- Triterpenoids, lucidone A, ganoderic acid B, and ganoderic acid C2 also in *G. lucidum*
- Hepatoprotective activity in mice
- Antitumor effect
- Increased serum interferon levels and augmented splenic NK cell activity in mice, i.p.





### *Ganoderma curtisii*

- Yellow and orange-capped species
- Grows in se U.S.



### *Grifola frondosa* Maitake

- Highly regarded in Japan where people “danced” with joy when they found it
- Prized as an edible in Europe, North America, Asia
- Clinical studies sparse
- Heavily promoted in N.A. and Asia as a dietary supplement



### *Grifola frondosa* Clinical Indications, Dose

Supportive treatment for:

- Hypercholesterolemia
- Hypertension
- Cancer, especially bladder cancer
- Hepatitis
- Non insulin dependent diabetes, blood sugar imbalances

Therapeutic dose:

- 2 grams watery extract powder, 3 x daily
- 3-12 grams powdered fruiting body

### *Grifola frondosa* Clinical Trials

Controlled

- After an average follow-up of 71 months in 146 patients with bladder cancer treated by partial cystectomies, the recurrence rate was 33% compared with 65% for controls (*G. frondosa*, zhu ling)

### *Wolfiporia cocos* Hoelen, Fuling



- One of the most widely-prescribed herbal drugs in traditional Chinese medical prescriptions
- Sliced and dried mushroom tuber or “sclerotium” or the skin is used in traditional medicine
- The fungus infects the roots and stumps of pine and other conifers
- Range: eastern Asia, e. Australia, se North America, Africa
- Used for food and medicine in Nigeria

### *Wolfiporia cocos* Clinical Trials

- No clinical trials on *W. cocos* alone.
- Clinical reports: used to treat cardiac arrhythmias
- Decoction of the skin studied in China for treating coughs, edema, as a diuretic.
- Used as an abortifacient in Korea

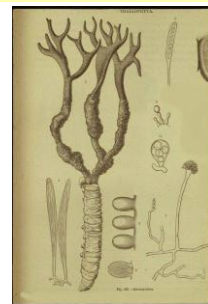
### *Wolfiporia cocos* Clinical Indications, Dose

- **In traditional Chinese medicine**
  - Increases urine output, clears dampness; difficult urination, diarrhea, edema due to fluid stagnation
  - Symptoms such as anorexia, diarrhea, abdominal distention (due to Spleen Qi deficiency and dampness)
  - Symptoms such as palpitations, headache, dizziness, palpitations, headache, dizziness due to phlegm congestion
  - Heart palpitations, insomnia, headache, dizziness due to disturbance of the “Heart system” or shen (spirit)

Dose: 9-15 grams up to 60 grams; 2-4 grams extract

### *Cordyceps sinensis* Cordyceps, Dong Chong Xia Cao

- “Summer plant, winter worm”
- Formerly only available to Chinese royalty; now cultivated
- Chinese Olympic running team claimed success due to cordyceps
- Thought to promote stamina, sexual vitality



### *Cordyceps sinensis* Clinical Trials

#### Controlled:

- Positive effects on hyperlipidemia compared with controls
- Reduced aminoglycoside nephrotoxicity in elderly patients in a small (n=21) trial.

#### Uncontrolled:

- Reduction of cyclosporin nephrotoxicity in kidney-transplant recipients.

### *Cordyceps sinensis* Biological Effects

- Immunostimulating actions, in vivo
  - Increased macrophage activity
  - Significantly increased survival span with lymphoma, in vivo
  - Increased platelet production
  - Stimulation of B-lymphocytes
  - No effect on humoral immunity
  - Methanolic extract suppressed IL-1beta, IL-6, TNF-alpha, and IL-8 cytokines
  - Modulated TH1 and TH2 cell functions in bronchial airway
  - Increases survival time of mice with lupus

### *Cordyceps sinensis* Biological Effects

- Cardioprotective, in vivo
  - Positive inotropic and negative chronotropic effects, relaxation of aorta and bronchus (in vitro)
  - Inhibition of thrombi formation and platelet aggregation
- Bronchodilation
- Sedative, hypnotic
- MAO-inhibition
- Antibacterial
- Enhancement of liver ATP status in liver

### *Cordyceps sinensis* Clinical Indications, Dose

- Convalescence
- Antiaging
- Immunosuppression
- Asthma, bronchial and lung inflammation
- Adjuvant in protocols for treating cancer
- Nephritis; nephrotoxicity in kidney-transplant patients induced by cyclosporin
- nephrotoxicity in elderly patients
- Hyperlipidemia
- Therapeutic dose: 3-10 grams 3 x/day mycelium grown on grain or soy; 3-12 grams/day watery extract; 1-2 ml, 3 x daily ethanolic extract

## Cordyceps Traditional Indications, Dose

- **PROPERTIES** sweet, warm
- **CHANNELS ENTERED** Lung, Kidney
- **KEY CHARACTERISTICS** gently tonifies the Kidney yang, augments the essence, tonifies the Lungs, settles coughs and wheezing, stops sweating
- **DOSAGE** 3-9g
- **CAUTIONS & CONTRAINDICATIONS** Use with caution in those with exterior conditions.



## Oyster Mushroom *Pleurotus ostreatus*

- Widely cultivated, 3<sup>rd</sup> most commonly available in markets
- Grows on alder, tanbark oak; other hardwoods
- Cholesterol-lowering properties

## *Pleurotus ostreatus* Biological Effects

- **Antihyperlipidemic**
  - Total cholesterol fell up to 33%, also LDL, VLDL, triacylglycerol, but not HDL (5% of diet in rats, rabbits)
  - Mevinolin, crude form of Lovastatin found in *Pleurotus* cultures (>23 mg/100 mL)
  - Mushroom extract inhibits HMG CoA reductase
- **Antitumor**
  - Inhibits colon cancer in rats (15% of diet)
  - Natural killer cell (NK) and lymphokine-activated killer (LAK) cells attacked tumor cells

## *Pleurotus ostreatus* Clinical Indications

- **Clinical indications**
  - Hypercholesterolemia (2 g/kg/day = 4 ounces/day)
  - Reduction of colon cancer risk, other cancers (with significant amount in diet--up to 15%, 5% showed few benefits)

**Dose: mushroom powder: up to 120 grams (4 ounces)/day in diet**

**Side Effects, Contraindications: rarely, contact dermatitis**

## *Schizophyllum commune* Split-Gill

Note split-  
"gills"



\* Tumor-reducing extract called schizophyllan is produced in Japan

## *Schizophyllum commune* Biological Effects

- Antitumor
- Restores natural killer cell activity to normal in mice with cancer
- Increases resistance against bacterial infection
- Good protective effects against damage of the bone marrow against chemotherapy

## *Schizophyllum commune* Clinical Trials

- Survival rates significantly increased in studies of 367,323 patients with gastric cancers when given with chemo and/or radiation
- Better 5-year survival rates in women with stage II cervical cancer when given with radiation therapy, along with stronger T-helper cell activity and improvements in other immune functions
- Open trial showing benefits in 11 patients with chronic fatigue syndrome

## *Schizophyllum commune* Clinical Indications

- **Clinical indications**
  - Gastric cancer (with chemotherapy and radiation)
  - Cervical cancer
  - Oral carcinoma
  - Hepatitis B (theoretical), chronic fatigue syndrome
  - Infectious diseases
- In traditional Chinese medicine:
  - leucorrhea
- Dose: 9-16 g in decoction, 3X/day

## *Armillaria mellea*

- Honey mushroom attacks live hardwoods, including fruit trees
- Massive mycelial networks cover many acres, one of Earth's oldest living organisms



## *Armillaria mellea*

- **Clinical indications**
  - Hypercholesterolemia
  - Anticonvulsant
  - Leg pain, epilepsy
  - Improve night vision
  - Increases blood flow to brain: dizziness, insomnia, neurasthenia, tinnitus
- **Dose:** fruit body, 30 gr; tincture, 1-3 ml (b.i.d.)
- **Contraindications, Side Effects:** don't exceed recommended dose; diarrhea
- **Clinical trials**
  - Open trials: reduces hypertension, benefits neurasthenia
- **In vitro, in vivo studies**
  - Antibacterial, antifungal
  - Antitumor effects
  - Decreases heart rate, reduces peripheral arterial resistance, increases coronary oxygen efficiency

## *Fomes officinalis* Quinine Conk

- "Panacea mushroom of the ancient Greeks"
- Major ingredient of Mithridate, Warburg tincture
- "Quinine conk" in the early U.S.; shot from trees with rifles for sale as quinine substitute



## *Fomes officinalis*

- **Clinical indications**
  - Panacea according to Dioscorides, Gerard
  - Hypercholesterolemia
  - Toxemia
  - Constipation
  - Antimalarial
  - Bronchial asthma
  - Night sweats
- **Dose**
  - 3-5 grams/day decoction, 1-2 ml tinc.
- **Clinical trials**
  - none
- **In vitro, in vivo studies**
  - Antitumor
  - CNS depression in high doses



### *Inonotus obliquus* Chaga

- Sterile conk that grows on yellow birch in the U.S., Europe, Russia
- May protect tree after injury
- Absorbs betulinic acid, an antitumor compound



Renowned cancer remedy in Russia

### *Inonotus obliquus*

- Studies show antitumor, anticancer effect
- Some clinical trials from Russia show benefit in cancers
- Common on yellow birch in Vermont, NY



### *Ustilago maydis* Corn Smut, Cuitlacoche

- Grows on corn kernels
- Delicacy in Mexican cooking
- Similar, but much milder action than ergot
- Contains uterine-contracting alkaloids
- Official in the USP
- Uses: postpartum bleeding, partus preparator
- Dose: 1-3 ml



### *Auricularia auricula* Wood Ear

- *Auricularia polytricha* is used interchangeably according to the Pen T'sao
- Used in Chinese cooking
- In Europe, wood ear was boiled to treat throat inflammation, eye irritation
- Biological effects: antitumor, antiulcer effect, hypocholesterolemic, antidiabetic, beta-cell protective effect, antioxidant, antiaging



Wood ear in the Amazon

### *Auricularia auricula* Wood Ear

- Uses in TCM:
  - Moves blood, stops pain
  - Increases physical, mental energy
  - Slows excessive uterine bleeding
  - Eases abdominal pain
  - Low back pain
  - Debility after childbirth
  - Muscle spasms
  - Poor circulation
  - Clears phlegm, strengthens lungs



### *Boletus edulis* King Bolete, Porcini

- Delicious mushroom on all continents
- Cancer-protective effect



### *Fomitopsis pinicola* Red-Belted Polypore

- Common polypore on conifers, especially Douglas fir
- Paste applied to wounds
- Kings: intermittent fevers, chronic diarrhea, neuralgia, nervous headaches, excessive urination, jaundice, fevers of tuberculosis



### *Amanita muscaria* Fly Agaric

- Mother tincture used homeopathically for epilepsy



### Death Cap *Amanita phalloides*



- Contains 2 kinds of liver toxins; destroys liver cells; possibly deadly
- Milk thistle has reduced death rate to 0 in Europe
- CDC has refused to use it in the U.S.

### *Silybum marianum*



### *Lenzites betulinus* Gilled Polypore

- Used in China in "Tendon-Easing Pills"



### *Piptoporus betulinus* Birch Polypore

- Grows in eastern hardwood forests on birch
- Some immunomodulating effects shown



*Pycnoporus cinnabarinus*  
Cinnabar Polypore

- Used in the Amazon and Southeast Asia in medicinal teas

