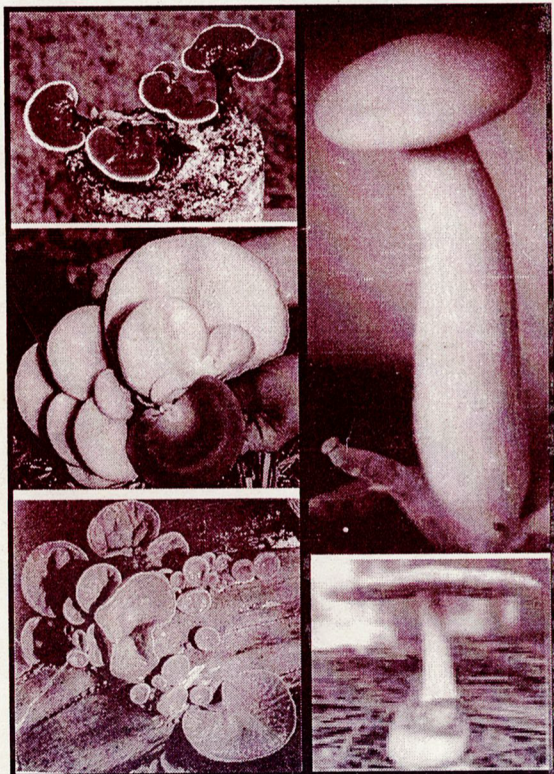




MUSHROOM TODAY

2

INFORMATIONS FOR DOCTORS 1



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MUSHROOM TODAY

Quarterly

with a New Face

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Introduction

Many people have got the faint knowledge that mushrooms have immense medicinal importance and should be included in the daily food habit. This knowledge is in a floating stage in indiscriminate patches also for the doctors. If the doctors do not have well justified and evidenced knowledge of the importance of mushrooms, they are at a fix to prescribe it to the people. We think that doctors can play a big role to put mushrooms regularly in the kitchen. We like to serve the doctors by providing them with concrete knowledge in the form of excerpt from research papers which will enable them to be confident and write Rx mushrooms in daily food.

We also welcome the Doctors those whom we intend to serve for their valuable suggestions so that we can render our services to you better.

Service 1.

Excerpts from "A MUSHROOMING INDUSTRY"

By Yoshiyuki Sasaki

Published in "PACIFIC FRIEND" January 1993

Vo. 20 : No. 10, Pg. 1-9

..... association with "health foods" is a new element in the Japanese people's love of mushrooms. True, the mushrooms is virtually free of calories and is rich in vegetable fiber, vitamins B1 and B2, and minerals - which makes it the perfect diet food. In addition, eating mushrooms does seem to prevent adult diseases by helping to remove cholesterol and lower blood pressure. And since shiitake is rich in vitamin D2, without which the human body can't absorb calcium, it helps strengthen the bones. One folk remedy handed down from the past brewing and drinking a broth from a certain member of the Sarunoko Shikake strain-is said to have an anti-cancer effect. According to some medical researchers, Lentinan extracted from shiitake enhances the body's immune system and checks the growth of malignant tumors.

There is even a report which seem to demonstrate that the incidence of cancer is lower among mushroom growers than among the general public.

One polysaccharide substance extracted from kawaratake and shiitake mushrooms is being used as an anti-cancer clinical drug at a number of hospitals, including the National Cancer Center. At the academic meeting of the Pharmaceutical Society of Japan held in March 1992, it was reported that Glucan contained in maitake mushrooms enhances the immunity of cells infected with the AIDS virus. While many researchers are embarrassed by the way mushrooms are some times trumpeted as panacea, the image of mushrooms as a health food seem to be firmly established.



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Medicinal properties of Oyster Mushroom

Pleurotus or Oyster Mushrooms contains 8 kinds of amino acids, as well as Vitamin B1, B2 and P (Ying, 1987). One analysis revealed appreciable amounts of all essential amino acids with the exception of tryptophan, and the protein quality was high enough to nearly equal animal-derived protein (Eden & Wuensch, 1991). Grown on wheat straw Oyster Mushroom contains minerals (7.9%), crude fiber (12.0%), lipids (4.2%), protein (15.7%), and carbohydrates (54.4%) (Garcha, 1993). The main fatty acid in the fruit-body is oleic acid (Solomko, 1984), and the saturated to unsaturated fatty acid ratio is 14 (saturated) to 86 (unsaturated) (Bano & Rajarathnam, 1988). The major organic acids in the fruiting bodies include formic, malic, acetic (the most abundant at 266 mg/ 100 g), and citric acids.

There have been some rather encouraging results in the study of the effect that oyster mushrooms have on cancer. Antitumor activity of Oyster mushroom as part of the normal diet was found in a feeding study in mice with sarcoma 180. The inhibition rate reached 79.4%, and against a mammary tumor system (MM-46) there was an 89.7% tumor inhibition rate (More, et al., 1986). By injection (i.p.), Oyster mushroom (200 mg/kg/day X10) produced a 75.3% inhibition of tumors (Ikekawaa, 1969). An acidic polysaccharide fraction of this mushroom showed a 95% tumor inhibition rate against sarcoma 180 from doses of 5 mg/ kg (Yoshioka, et al., 1972).

The dried and powdered mushroom fed to hamsters at 2% of a high-fat diet for 6 months lowered serum very low density lipoprotein (VLDL) in blood plasma, as well as cholesterol and triglycerol levels, in the liver more than in controls. Serum VLDL decreased by 65-80% , and total serum lipid levels were reduced by 40%. A polysaccharide from the

mushroom as part (4%) of a normal diet was found to lower serum and liver levels of cholesterol accumulation by 45% in 3 months (Bobek, et al., 1993). Rats with hereditary high cholesterol levels also showed significantly reduced levels of serum cholesterol from feeding on the mushroom a part of the diet (4%) . Even with 1% cholesterol added into their feed, these rats showed a nearly 40% decrease in cholesterol levels (VLDL and LDL) (Bobek, et al., 1991a). (There have been no clinical studies of this kind done on human beings.)

Oyster mushrooms may be an excellent blood-builder. According to published results, it has up to 19 mg/ 100 grams (dried) of iron. In animal feeding studies, the addition of oyster mushrooms to the diets of anemic albino rats raised hemoglobin content to 15.5 to 16.2, which compares with 8.2 for controls fed copper and milk. The oyster mushrooms used in this study were *P. sajor-cajor* and *P. flabellatus*.

In China, oyster mushrooms are used for joint and muscle relaxation (Yang & Jong, 1989); when the sporophores are made into "tendon-easing powder," they are effective in the treatment of lumbago, numbed limbs, and tendon and blood vessel discomfort.

In the Czech Republic, extracts have been made from oyster mushrooms as the main ingredient in dietary preparations recommended for prevention of high cholesterol (Opletal, 1993).

Although the different types of oyster mushroom are similar to some degree, some have properties that set them apart from other varieties. For instance, there is a variety called *P. griseus*, that contains a highly active antibacterial substance named "pleurotin." Some varieties of oyster mushrooms have more or less nutritional content than others, and some have not been fully studied yet.



Mushrooms Support the production and health of white blood cells

More than a dozen varieties of mushrooms have been shown to be potent immune boosters with use in Asia in excess of 3000 years. Composed of a variety of different sized molecules useful in the human body, medicinal mushrooms support the production and health of white blood cells in several ways. The larger molecules, called polysaccharides, contain some of the mushroom's most active medicinal qualities. These molecules have antitumor, antiviral, and antibiotic properties.

Mushroom Emperors has an excellent blend of 6 of the best known medicinal mushrooms. The following is a sampling of the benefits these mushrooms may offer.

MAITAKE (*Grifola frondosa*)

Shows benefits as a tonic, with specific benefits for lowering blood pressure, reducing serum cholesterol, lowering blood sugar, and weight loss. Contains beta-glucan, helps boost the body's own immune responses including natural killer cells, cytotoxic T- cells, macrophages, super oxide anion cells and interleukin.

REISHI (*Ganoderma lucidum*)

A traditional tonic used to nourish, tonify, and supplement the whole body as it removes toxins and disperses accumulation. As a tonic it calms and nourishes the nervous system, strengthens the lungs, protects and stimulates the liver and helps the body adapt to stress.

WHITE JELLY LEAF **(*Tremella fuciformis*)**

Modern research indicates its usefulness as an anti-tumor agent, in enhancing red blood cell production, lowering cholesterol, and protecting against radiation.

CORDYCEPS (*Cordyceps sinensis*)

Used to strengthen and re-build the body (particularly the endocrine system) after disease and exhaustion. Enhances depressed immune functions including the macrophage, B-lymphocytes and natural killer cells.

ROYAL AGARICUS **(*Agaricus blazei-murill*)**

Studies demonstrate possible use in recovery from cancer as well as in prevention of the imbalance. May also turn out to be a longevity aid.

LION'S MANE **(*Hericium erinaceus*)**

Studies done primarily in Asia confirm many of its traditional uses, supporting the cardiovascular system (lowering blood pressure and serum cholesterol) strengthening the respiratory system, and acting as a tonic for the nervous system. One very promising benefit may be to possibly be able to stimulate nerve growth factor.



Immunity booster

FOOD FUNDAS / Vitamin B5

PANTOTHENIC ACID or vitamin B5 is a water soluble vitamin that is important for the metabolism of fat , protein and carbohydrates. It also stimulates the adrenal gland to produce cortisone and other hormones, which assist the metabolism. It protects against stress and helps the body fight allergies and maintain healthy skin , hair, muscles and nerves. It is used in the creation of lipids, neurotransmitters, steroid hormones and haemoglobin.

Stress, allergies, too much alcohol and refined food intake may cause its deficiency. Symptoms of vitamin B5 deficiency include fatigue, headache, nausea, tingling in the hands, air loss, depression and cardiac instability.

“Since vitamin B5 is found in all food except fruits, there are no required daily allowances for it,” says nutritionist Ishi Khosla from the Centre for Dietary Counselling . It is best taken with the B group vitamins, vitamin A, vitamin C and vitamin E.

Vitamin B5 per 100 gm of.....

Wheat germ :	1.2 mg
Brown rice :	1.1 mg
Wheat flour :	1.1 mg
Soyabean flour :	2 mg
Split peas :	2 mg
Soyabean :	1.7 mg
Lentil :	1.4 mg
Mushroom :	2.2 mg
Brocoli :	1.2 mg
Cauliflower :	1 mg
Peanuts :	2.8 mg
Sunflower seeds :	1.4mg
Cashew nut :	1.3 mg
Liver :	8 mg

(Source Hindusthan Times Health)

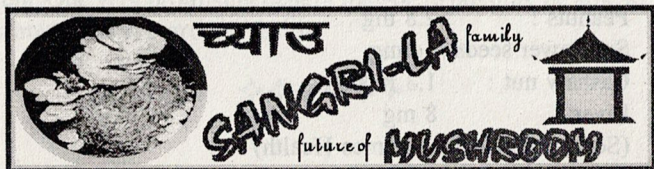
Mushroom - a food for growing children

For every child "variety is the spice of life", and this especially includes his diet. So why not try to switch over from the usual monotony of vegetables to mushrooms, which is much more tasty and nutritious, than any other vegetables.

Growing children require, "vital" elements, they require proteins for growth. Mushrooms contain proteins which consists of all the essential amino acids required by an individual. These amino acids help in building up muscles. Example of essential amino acids present in good concentration in mushrooms but not in vegetables is Tryptophan and Lysine. Therefore-the supplementary value of mushroom protein in vegeteraian diet is significant.

Growing children require calcium to be supplied to his growing bones. Mushrooms contain calcium, which develop healthy bones and teeth. It also contains Vitamin D2 without which calcium absorption is not possible.

It contains minerals such as Calcium, Phosphorus, Iron, Sodium and Potassium. Each mineral has a specific function in our body. The Iron present helps in the formation of blood. Mushroom also contains a Vitamin - known as folic acid on Bm, this Vitamin also helps in the process to combat anemia. The Sodium and potassium present help in controlling nerve co-ordination and ultrafiltration in kidney. Besides this, the importance of 90% water present in mushroom is beyond comprehension. A certain antigen present in mushrooms fights against influeaza virus.



Mushroom magic fights cancer

BBC News Monday, 19 August, 2002, 11:28 GMT 12:28 UK

Edible mushrooms may help fight disease

Exotic mushrooms may hold chemicals which could help scientists develop new cancer drugs, it is claimed.

Cancer Research UK has researched the use of mushrooms in traditional medicines in Asia.

Research there suggests that some have anti-tumour properties.

Trials in the US, Japan and China suggest that chemical compounds derived from fungi may prolong the survival of cancer patients.

However, some trials carried out in the Far East may have to be repeated elsewhere before scientists are convinced of their findings.

Death rates - One survey of Japanese mushroom workers found that those who produced edible mushrooms - suggesting consumption by workers - had a far lower death rate from cancer than those who produced non-edible mushrooms.

"Medicinal mushrooms" may also be able to relieve the side-effects suffered by patients with advanced cancer.

Dr Richard Sullivan, from Cancer Research UK, said: "A vast amount of information has been collated which suggests that compounds derived from mushrooms could have a hugely beneficial influence on the way cancer is treated."

While there is evidence that extracts of rarer mushrooms such as shiitake, enoke and oyster may be beneficial, the humble British button or flat mushroom is likely to possess none of these abilities.

Remedies - More than 100 species are used by traditional Chinese medicine practioners to form remedies for a wide variety of ailments.

They are often taken as powdered concentrates or extracts in hot water drinks.

Professor John Smith, from the University of

Strathclyde, who led the review, said: "There is now increasing evidence that the medicinal mushrooms offer a remarkable array of medicinally important compounds that have yet to be evaluated by western medical scientists."

Mushroom remedy 'makes you fit'

BBC News Monday, 19 April, 2004, 10:15 GMT 11:15 UK

A Chinese mushroom improves the fitness of middle-aged and elderly people, research suggests.

Tests showed people aged between 40 and 70 who lived a sedentary lifestyle became fitter after taking an extract of the Cordyceps mushroom.

The research presented to the American Physiological Society indicated an improvement in the ability to exercise and a reduction in tiredness.

However, UK experts said scientific proof for the remedy was lacking.

The mushroom became a Chinese remedy around 1,500 years ago after herdsmen in the Himalayas noticed a significant increase in their herds' strength and agility after eating it.

It is now marketed in the West.

The performance of Chinese women athletes in setting several new records at a tournament in 1993 was due to high-altitude training and using a tonic derived from the mushroom, their coach said.

Researchers at Pharmanex in California, which produces a remedy called CordyMax, tried it out on 131 volunteers.

Some were given the remedy and some a placebo over a 12-week period.

Researchers measured exercise capacity, endurance performance and metabolic alterations before, during and af

ter receiving the remedy or placebo.

Oxygen - Volume of oxygen consumption went up 5.5% in the group given the remedy, but only 2.2% in the others, suggesting an increase in aerobic capacity.

The time taken to complete a one-mile walk was reduced by 29 seconds in the CordyMax group but increased slightly in the others.

And diastolic blood pressure fell by 3.2% among people taking the remedy.

The researchers said: "This study provides scientific evidence that CordyMax is effective in enhancing aerobic exercise capability, endurance exercise performance, and exercise metabolism and alleviating fatigue in healthy humans."

Dr Jidong Wu, a lecturer at Middlesex University and president of the Association of Traditional Chinese Medicine, said there had not been scientific trials to establish the effectiveness of the mushroom.

He said: "There are not many clinical trials which are accredited by Westerners, but according to the ancient Chinese literature it is a tonic herb.

"In clinical practice, people taking it feel better, but scientifically how much, we don't know."

The mushroom was thought to improve the performance of the lungs and kidneys, he said.



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Anti-diabetic Mechanism by Maitake Mushroom - *Grifola frondosa*

Keiko Kubo, Hiroaki Nanba

Glucose tolerance test were conducted on KK-Ay mice, model animals of NIDDM (non-insulin dependent diabetes mellitus). The elevated blood glucose levels after 15 minutes and 30 minutes of Maitake-fed group were 0.64 times and 0.76 times of those of control group respectively, indicating inhibition of blood glucose increase with significance of differences. Then, insulin receptor capability of liver cells was examined under liver perfusion method. Down regulation was observed among Maitake-fed group, while the state of tolerance was seen among control group. Next, glucose absorption activity at enteron and sucrase activity at mucosa of the small intestine were examined. Both inhibition of glucose at the small intestine and inhibition of sucrase activation were not observed when Maitake powder or X-fraction was administered. These results suggested that Maitake's anti-diabetic activity is not related with the inhibition of glucose absorption at enteron, but with the process of metabolism of absorbed glucose.

Nutritional Information Protein : 2.90% Fat : 0.26% Carbohydrate : 6.30% Calories : 31.90% Fibre : 1.10% Ash : 1.00% Moisture : 85.90% Thiamine : 0.5 mg. Riboflavin : 0.5 mg. Nicotin : 10.9 mg. Ca : 3.3 mg. P : 124.8 mg. Fe : 1.3 mg. Na : 88.7 mg. K : 378.3 mg.	<p>We GANGRI-LA appreciate that you expect nothing but the best from us. That is why we take every care to ensure GANGRI-LA is a product of highest quality.</p> <p>GANGRI-LA : The Mushroom People - Jalpaiguri</p> <p>It's a DK's Product</p> <p>In case of any complaint kindly inform us of the nature complaint, piece of purchase of this pack.</p> <p>Pfl. : 0356 1-257749 (M) : 98320-63963</p> <p>MRP : PKD : CODE :</p>
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Biologically Active Substances from *Lentinula edodes* and *Pleurotus ostreatus*

N.A.Bisko, V.G. Babitskay, V.T. Bilay, N.Yu. Mitropolskaya,

The chemical compositions of fruiting bodies and mycelia after submerged cultivation of fourteen strains of *Lentinula edodes* (Berk.) Sing. and one strain of *Pleurotus ostreatus* (Jacq.:Fr.) Kumm. were studied. Palmitoleic (16:1) and heptadecenoic (17:1) fatty acids appeared upon submerged culture of the mycelia in both investigated species. *L. edodes* and *P. ostreatus* mycelia had higher indices of essential amino acids and nutrients, than did their fruiting bodies. The culture liquid contained 3-5 g/L of exopolysaccharides after submerged culture of *L. edodes* and *P. ostreatus*. The main component of these exopolysaccharides was glucose. The molecular masses of *L. edodes* and *P. ostreatus* exopolysaccharides were 180-200 kD and 200-220 kD respectively.

গ্রাহক / SUBSCRIPTION

প্রতি সংখ্যা - ২০.০০, ডাক খরচ - ৫.০০

বার্ষিক গ্রাহক মূল্য - ৮০.০০ (ডাক খরচ সামত)

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Antimicrobial and Antitoxical Action of Edible and Medicinal Mushroom *Pleurotus ostreatus* Extracts

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ABSTRACT :

Fourteen strains of *Pleurotus ostreatus* were investigated as possible producers of biologically active substances. After submerged cultivation, biologically active materials were isolated as extracts from cultural liquids and mycelia. Extracts were evaporated and dry residue dissolved. Antimicrobial activity was tested by the method of diffusion in agar medium inoculated with microorganisms. Disks saturated with solution were used. All strains manifest antimicrobial activity during submerged cultivation in experiments with extracts; cultural liquids demonstrated only minimal activity, so these strains have low levels of biosynthesis. Extracts of fruit bod

ies grown on corn were inactive. For the next investigation, one strain of *P. ostreatus* with the highest levels of biosynthesis was chosen. During submerged cultivation this strain produced two different substances with antibiotic activity, one with high activity against *Aspergillus niger* INA 00760 and the other with activity against Gram-positive as well as Gram-negative bacteria. Antifungal activity against *Aspergillus niger*/i> INA 00760, *Saccharomyces cerevisiae* RIA 259, and *Candida albicans* INA 00763 in mycelium extracts was not found. Mycelial extract was fractionated and it was shown that antimicrobial substance (or substances) in mycelial extract makes up not more than 1% of dry weight. Investigation of mycelial extract as anticancer and antitoxic drugs was studied in CBA mice. Anticancer action was tested in mice transplanted with Ehrlich's ascites tumor. Toxic effect (decreasing of body weight and leucopenia) was noted in animals after cyclophosphamide (CP) administration in doses of 100 mg/kg. Extract was administrated daily. The first extract injection was given 2 h after CP administration. A number of leucocytes in peripheral blood were studied after CP treatment, producing a decrease of leucopenia level during this period. According to our data, *P. ostreatus* extracts produce a decrease of CP hematotoxicity.



Ganoderma

Thi-Oriented Immunomodulating Activity of Gel-Forming Fungal (1(R)3)-Beta-Glucans

Yoshiyuki Adachi, Yoko Suzuki, Takafumi Jinushi,
Toshiro Yadomae, Naohito Ohno

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ABSTRACT :

The immunomodulating effects of various gel-forming (1(R)3)-beta-glucans on balancing helper T-cell activity were examined in a murine model. Plasma from mice injected with grifolan (GRN) from the edible and medicinal mushroom *Grifola frondosa* (Dicks.: Fr.) S. F. Gray [or alkaline-treated sonifilan (SPG-OH)] and trinitrophenyl ovalbumin (TNP-OVA) contained TNP-specific antibodies of both IgG1 (Th2-mediated) and IgG2a (Th1-mediated) isotypes. Administration of glucan (SSG) from *Sclerotinia sclerotiorum* (Lib.) de Bary IFO 9395 and TNP-OVA significantly augmented the synthesis of IgG2a antibodies, while the synthesis of IgG1 was reduced. Furthermore, intracellular cytokine staining showed a higher proportion of IFN-g-producing helper T cells in SSG-administered murine splenocytes. The highest IFN-g production was observed when adherent cells of mice administered TNP-OVA and SSG were cultured with TNP-primed lymphocytes. This effect of administration of SSG on IFN-g production was completely inhibited by addition of anti-IL-12 mAb. The content of the reduced form of glutathione in splenocytes was increased by SSG administration, suggesting type 1 immunoresponse. Depletion of lymphoid dendritic cell population from SSG-administered splenocytes reduced IFN-g production. In conclusion, our study showed that beta-glucans have various effects on the Th1- or Th2-dependent antibody subclasses and, in particular, that SSG induces the development of Th1 cells via the IL-12 pathway.

Second International Conference on Medicinal Mushrooms

Venue :- Pattaya – Thailand

Date – July 17, 18th 2003

Organised by :- Biothiland,

(BIOTEC) National Center for Genetic Engineering and Biotechnology.

National Mushroom Center.

Mushroom Researchers and Growers society of Thailand

SVITA Foundation.

Day 1 : July 17, 2003

Opening ceremony was attended by Her Royal Highness Princess Maha Chakri Sirindhorn, who has initiated various development projects aimed at improving the quality of life of Thai people. Mushroom project for the disabled initiated by FAO was cited in her acception of Franklin Delano Roosevelt International Disability Award, presented by UN Secretary General Kofi Annan at UN headquarters in New York on July 2, 2001.

Medicinal mushrooms: from anecdotal and mythtradition to modern biotechnology and pharmaceuticals

(Prof. Solomon P. Wasser)

Prof. Wasser of the University of Haifa, Israel, also editor-in-chief of International Journal of Medicinal Mushrooms, opened the Biothailand 2003 with his keynote lecture. He reviewed medicinal effects and usage of various mushrooms in the past, recent past & present.

He observed that mushroom production grew enormously in the second half of the 20th century mainly thanks to development of culture technologies and scientific & pub

lic understanding of the beneficial peroperties of edible and medicinal mushrooms. A rapid increase in shiitake cultivation is a case in point. The potential of application of mushrooms for medicinal purposes has been proposed by researchers and doctors. PSK & PSP from *Tremates versicolor*, Lentinan from *Lentinula edodes*, Schizophylan from *Schizophyllum commune* and the most lately, Befungin from *Inonotus obliquus* have been developed and approved as anti-tumor preparation.

Another of his observations is that presently an estimated 140,000 species of fungi exist, approximately 14,000 are known species, about 2,000 are safe, while about 650 possess significant pharmacological properties (appl. microbiol. biotechnol 2002).

He gave an outstanding overview on various medicinal mushrooms by medicinal effect and compound. Medicinal mushrooms have exceptional immunomodulatory, antitumor, anticholesterol, antidiabetic and hepatoprotective effects. They serve as wonderful biological response modifiers for they

1. do not harm nor place additional stress on the body

2. help the body to adapt to various environmental & biological stresses

3. support some or all of the major systems, including nervous, hormonal and immune systems as well as regulatory functions.

He chose Lentinan from *Leninula edodes* (shiitake) as #1 immunomodulator which activates immune cells, while citing *Flammulina velutipes* (enokitake), *Agaricus brasiliensis*, *Lentinula edodes* (shiitake) and *Schizophyllum commune* (Split gill) as formidable cancer fighters.

Lovastatin isolated from *Aspergillus terreus* is one of the most popular agents to lower the low-density lipoprotein (LDL) cholesterol level in the blood to be an effective medication against hypercholesterolemia and further coronary artery diseases. *Pleurotus* mushrooms are expected to be a potential provider of this competitive inhibitor of HMG CoA

reductase (a key enzyme in cholesterol metabolism).

In the meantime, Tremellastin whose major agent is glucuronoxylomannan, a polysaccharide from *Tremella mesenterica* (Jelly mushroom) is proved effective in lowering high levels of triglyceride, a strong and independent risk factor for cardiovascular diseases, and effective against diabetes.

Another polysaccharide named TAP isolated from a hot-water extract of the *Tremella* fruiting bodies has been observed to ameliorate glucose metabolism and increase insulin secretion in the body to be suggested as a promising treatment for diabetes along with Maitake (*Grifola frondosa*) products.

Last medicinal effect he went into was liver protecting activities from medicinal mushrooms. Lentinan & LEM from *Lentinula edodes* have exhibited positive results in treating chronic hepatitis and viral hepatitis B, the leading cause of death in Southeast Asia including Thailand. Reishi, *Ganoderma lucidum* was also cited as a liver protector, whose hepatoprotective effect mechanism was also proposed as follows:

- antioxidative & radical-scavenging effects**
- downregulation of activating enzymes**
- upregulation of detoxifying enzymes**
- antiviral activities**
- inhibition of beta-glucuronidase**
- enhanced hepatic nucleic acid and protein synthesis**
- inhibition of hepatic collagen synthesis**
- immunomodulating effects**
- modulation of nitric oxide production.**

What are bioactive compounds which have those above effects? Polysaccharides including glucan of Schizophyllan and Lentinan, glycoproteins including PSP (polysaccharopeptide from *Trametes versicolor*), KS-2 (alpha-mannan peptide from *Lentinula edodes*) and ATOM (glucomannan-protein complex from cultured mycelium of *A. brasiliensis*), terpenoids and others trace ingredients like

lectins, statins and dietary fiber were enumerated.

He cited *Tremella* submerged culture as an example of successful biotechnological application of the submerged culture method for producing immunostimulating polysaccharide glucuronoxylomannan from the haploid culture of yellow brain mushroom *Tremella mesenterica*. Advantages of one cell culture for biotechnological process are

1. it is an ideal case for exponential growth as each cell could give rise to two new ones.
2. metabolism of mycelial cultures is strongly dependant on form and size of mycelia pellets in submerged culture conditions.

Concluding his lecture, he gave us his estimation that the world production of cultivated mushrooms will be approximately 16-18 million tons/year with the value of world production and of medicinal mushroom products to be doubled \$40~50 billion (USD) per year in 2010~2012, and that the production of *A. brasiliensis* will exceed that of *A. bisporus*.

In the afternoon, poster & exhibition session, we could see mushrooms cultivated in Thailand. They grow common mushrooms like oyster, shiitake and mushrooms rarely grown but highly medicinally important like split gill (*Schizophyllum commune*), Lion's mane (*Hericeum erinaceus*) plus such tropical mushrooms as inky cap (*Coprinus comatus*) & paddy straw mushroom (*Volvariella volvacea*).



Auricularia

Development of products of mycelia and intra-and extrapolsaccharides from *Acremonium implicatum*, isolated from a *Cordyceps species*

(Dr. Zengzhi Li)

Dr. Li of Anhui Agricultural University (China) gave us an introduction to *Cordyceps sp.* & a product from mycelia and their medicinal effects, and intra/extra polysacchrides. His lab isolated *Acremonium implicatum* from fruiting body of *C. gunnii* var. minor. and produced a capsule from the submerged culture of *A. implicatum* mycelium.

The capsule is said to have shown such medicinal effects as immunemodulation (cellular/humoral and mononucleate macrophagosis), anti-rheumatic arthritis, hormone regulation, anti-senescence and liver function improvement. His experiments with mice showed the capsule exhibited cellular & humoral immunity & phagocytosis activity.

The lab also extracted various bioactive compounds from mycelium and/or fermented broth. Among them, intrapolsaccharides & extrapolsaccharides derived from *A. implicatum* showed the highest life span extension, hepaprotection & immunomodulation effects.

He also characterized both intra/extra polysaccharides. Gas chromatograph showed purified intrapolsacchride consists of glucose & galactose at the molar ratio of 3.8:1 while extrapolsaccharide is made up of glucose and mannose at the molar ratio of 2.8 : 1.37. the extra cellular polysacchride has a molecular weight 1.88×10^5 and a backbone of (1-4)-linked α -D-glucopyranosyl residue with a few side-chains of α -1,6 linkages.

Body-function Regulating Compounds from mushrooms

Prof. Hirokazu Kawagishi

Prof. Kawagishi of Shizuoka University reviewed the nerve system protective effects of *Hericium erinaceus* (Monkey head, Lion's mane). Dementia is one of the hardest nerve diseases to cure. Recently lack of nerve growth factor (NGF) and the cytotoxicity of amyloid-peptide are suggested as causes of nerve-cell diseases such as Alzheimer's dementia. He suggested that the monkey head mushroom could be an answer to the disease as it stimulates NGF synthesis while protects nerve cells from amyloid-peptide.

Active compounds hericenones C to H and a series of diterpenoids named as erinacines A to I were isolated from its fruiting bodies and mycelia, respectively. In animal tests with rats with dementia, hericenone C and erinacine A were proved effective against dementia by stimulating NGF synthesis.

His lab also isolated NGF stimulants from such mushrooms as *Sarcodon scabrosus* and *Dictyophora indusiata*.

Scientists have long known that amyloid-beta peptide, a precursor protein involved in Alzheimer's disease, collects in sticky clumps called "neuritic plaques" outside of nerve cells in the brain, and eventually kills them. Other compounds were also derived and named "YAC-1" that could protect nerve cells from the cytotoxicity by amyloid-peptide and tunicamycin.

Genoprotective activity of mushroom components

Prof. John A. Buswell

The professor of biology at the Chinese University of Hong Kong, who is move to his new position at Shanghai Academy of Agricultural Sciences, discussed the effects of mushroom-derived preparation (MDP) against oxidative damage to DNA, which otherwise, could cause aging, cancer and heart diseases. Dietary supplements including soybean, green tea and herbal medicines are widely used for anti-aging and

genoprotection. How about mushrooms?

Hot (100°C) & cold (20°C) water extracts of fruitbodies of different mushrooms were prepared and screened for their ability to protect genes against oxidative damage to DNA by using single-cell gel electrophoresis (Comet) assay.

Highest genoprotective function were obtained water extract of *A. bisporus* (Ab-cold) and hot water extract of *G. lucidum* (Gl-hot).

Genoprotective compound in *A. bisporus* cold water extract proved to be tyrosinase, which hydrolyzes tyrosine to L-DOPA and then to dopaquinone. This oxidation process is supposed to catalyzes the cellular antioxidation. It was so amazing antioxidation products can be produced from low-cost edible mushrooms like *A. bisporus*.



Volvariella

Mushrooms may work wonders in cancer treatment prevention

Media Release date : 19 August 2002

Exotic mushrooms could herald a new era of cancer treatment and prevention as the Western world learns lessons from the Orient according to a report released by Cancer Research UK today (Aug 19th).

The charity has produced the world's most comprehensive review of information about the way medicinal mushrooms are used in Japan, China and Korea where they have been reported to have antitumour properties and to stimulate the immune system to fight disease.

It also documents evidence from studies in the Far East that medicinal mushrooms can help reduce side effects from radio and chemotherapy and significantly improve the quality of life in patients with advanced cancer.

Dr. Richard Sullivan, head of clinical programmes for Cancer Research UK, said : "A vast amount of information has been collated which suggests that compounds derived from mushrooms could have a hugely beneficial influence on the way cancer is treated"

Some trials in Japan, China and, more recently in the US, are indicating that chemical compounds derived from medicinal mushrooms can prolong survival of cancer patients. But there is concern that the standards of trials in the East may not meet current Western regulatory requirements.

"We hope that with the publication of this report more Western cancer doctors will be encouraged to set up trials to assess the potential of these compounds in treating cancer", said Dr. Sullivan.

Professor John Smith from the University of Strathclyde, who led the review, said: "There is now increasing evidence that the medicinal mushrooms offer a remarkable array of medici

nally important compounds that have yet to be evaluated by Western medical scientists.

“Mushrooms are also very nutritious as food because they contain all the essential amino acids and are an excellent source of vitamins. Evidence suggests that exotic mushrooms – such as the shiitake, enoke and oyster varieties which are used in many modern recipes – have major dietary benefits. But while the large flat mushrooms and the button variety found in most shops are highly nutritious, there is not documented evidence that they have the exotic mushroom’s special medicinal properties.”

Medicinal mushrooms taken as powdered concentrates or extracts in hot water are believed to enhance the immune responses of the body and help overcome disease. And Prof. Smith says that many show cholesterol lowering ability and many have importance in cardiovascular diseases.

A survey conducted over 14 years among Japanese mushroom workers in the Nagano Prefecture implied that a regular diet of edible medicinal mushrooms was associated with a lower death rate from cancer than of other people in the Prefecture.

The average cancer death rate in the Prefecture was one in 600. But the rate dropped to one in 1000 among farmers who produced edible mushrooms.

More than 100 species of mushroom are documented by practitioners of Chinese medicine as treatments for a wide range of ailments. And many mushroom-derived medicinal products are already manufactured by Japanese, Korean and Chinese pharmaceutical companies.

Mushrooms have long been valued as tasty, nutritious food by different societies throughout the world. To the ancient Romans they were the “food of the Gods” resulting from bolts of lightning thrown to the earth by Jupiter during thunder storms; the Egyptians considered them as “a gift from the God Osiris” while the Chinese viewed them as “the elixir of life....”

Other cultures, notably those in the UK, Ireland and much of North America, have grown up with a fear of mushroom poisoning. By contrast fungus-loving societies are found throughout Asia and in much of Europe – especially Poland – and Russia where wild mushrooms are extensively collected or bought and incorporated into soups, stews and teas.

Sir Paul Nurse, Chief Executive of Cancer Research UK, says: “The information coming out of the East about the apparent benefits of mushrooms for health and the potential to help treat cancer patients is very interesting. More work needs to be done on how mushrooms can be used in Western medicine. This report gives weight to the argument for clinical trials to be set up to try to validate research done in other parts of the world, which may not have met all the criteria laid down in western medicine”.

Ends.

Media contact : Cancer Research UK press office

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Shiitake

Mycological Medicine

Mushrooms may prove beneficial for immunity and more

The stress and pressure of modern society take a toll on immune system health. Those with weakened immunity are more susceptible to infection and disease.

The need to maintain or rebuild a healthy defense has led researchers to minerals, plants and fungi in search of natural health-supporting properties. The fungi family in particular shows promise for its ability to enhance immune function.

Mushrooms grow wild in many parts of the world and are also commercially cultivated. Nutritionally, mushrooms are a valuable health food low in calories and carbohydrates; healthy in vegetable proteins and essential amino acids; a source of some fiber; and rich in a number of important vitamins and minerals, including B vitamins, selenium, iron, potassium and zinc.

Mushrooms have been used medicinally for centuries in traditional Chinese and Japanese medicine. In many Asian cultures, mushrooms are used to promote good health and vitality and to increase the body's adaptive capabilities. Although the nutritional facts and culinary uses of mushrooms are well-accepted in the West, the fungi's medicinal qualities have yet to make the mainstream.

Of the hundreds of known mushroom varieties, several have been studied for their ability to enhance the human immune system and fight infections. Some well-known medicinal mushrooms with benefits for the immune system include reishi (*Ganoderma lucidum*) shiitake (*Lentinus edodes*), maitake (*Grifola frondosa*) and cordyceps (*Cordyceps sinensis*). Some of the less familiar mushrooms include bai mu erh (*Tremella fuciformis*), fu ling (*Poria cocos*), zhu ling (*Grifola umbellata*), lion's mane (*Hericium erinaceus*), Au

ricularia auricula-judae and *Coriolus versicolor*.

Researchers recently studied some of the isolated chemicals from a number of Basidiomycetes mushrooms a large group of fungi whose members range from the familiar button mushroom to rusts and smuts that sometimes ravage crops. The constituents show promising immune-modulating, antibacterial, antiviral, antitumor, antiparasitic, cardiovascular and hypercholesterolemic effects. In fact, mushrooms have an impressive effect on the cardiovascular system. Researchers have found that numerous varieties such as maitake, shiitake and cordyceps can reduce total cholesterol levels, reduce the "bad" cholesterol (low-density lipoproteins) and triglycerides, decrease platelet binding, and reduce arterial pressure. Mushrooms also can affect glycemic levels and inflammatory conditions.

In addition to these promising preliminary findings, scientists have also noted that mushrooms have definite primary and secondary physiological effects on the human immune system. Israeli researchers noted in 1999 that cellular components and secondary metabolites of many mushrooms affect the immune system of the host and therefore could be used to treat a variety of disease states.

Medicinal mushrooms' powerful immune-modulating and potentiating activity helps support and enhance overall immune function. Researchers are also finding that mushrooms can directly stimulate both the basic (lymphocyte, neutrophils, etc.) and secondary immune responses (immunoglobulins IgE, IgA, IgG) of the immune system. This leads to increased production of immune defenders such as macrophages and cytokines, which play vital roles in recognizing and removing foreign antigens, as well as releasing chemical mediators including interleukin-1.

In recent studies on medicinal mushrooms, researchers have used modern analytical and laboratory techniques to significantly improve isolation and identification of bioactive chemicals. These techniques have revealed mushroom substances with antimicrobial activity. A 1999 study in Japan

found three kinds of antibacterial substances in shiitake mushrooms that were effective against *Streptococcus spp.*, *Actinomyces spp.*, *Lactobacillus spp.*, *Prevotella spp.* and *Porphyromonas spp.* of oral origin. A study in Spain found that 45 percent of 317 isolated (extracted) substances from 109 polypore and gilled mushroom species showed antimicrobial activity. Some mushrooms have generalized antimicrobial effects, while others have quite specific properties. This dual capability is important because it provides two separate methods of immune enhancement and response, which is important for treating specific microbial infections such as gram-negative streptococcal and herpetic virus microbial infections and disease states such as sarcoma cancers, leukemia and hepatitis.

Substances that have been found to potentiate the immune system include beta-glucans, lentins, polysaccharides, polysaccharide-peptide complexes, triterpenoids, nucleosides and other secondary metabolites. Many of these bioactive substances, through their stimulatory effects on the immune system, are showing powerful antitumor, antimutagenic and anticancer activity.

Beta-glucan is isolated from shiitake and maitake mushrooms, as well as from yeast cell walls and from oat and barley bran. It has 1,3- and 1,6-glucose links. The 1,3 refers to the sites at which glucose molecules are connected to form the glucan backbone. The 1,6 refers to the bonding sites between a glucose molecule on the backbone and on the side chains.

Beta-glucan binds to macrophages and other phagocytic white blood cells at certain receptors and activates their anti-infection and antitumor activity by stimulating free-radical production. This in turn signals the phagocytic immune cells to engulf and destroy foreign bodies, be they bacteria, viruses or tumor cells.

Three separate multicenter, randomized, double-blind, placebo-controlled clinical trials have been conducted two at Harvard Medical School using beta-glucan

on patients undergoing high-risk major abdominal and thoracic surgery or high-risk gastrointestinal surgery. Patients in one study who received high-dose beta-glucan (2.0 mg/kg) had significantly fewer postoperative infectious complications compared with placebo. In another, beta-glucan patients experienced 1.4 infections per patient vs. 3.4 infections in the placebo group. In the third study, of 1,249 patients, beta-glucan patients had a statistically significant 39 percent reduction in serious infections and death compared with placebo. The investigators concluded that beta-glucan was safe and well-tolerated and could potentially decrease postoperative infections.

Medicinal mushrooms' potential tumor-inhibiting effects have led to a recent surge of research in this particular area. In a 1999 study in Japan, researchers isolated a polysaccharide from the mushroom hime-matsutake (*Agaricus blazei Murrill*) that proved to have antitumor effects against sarcoma 180. In a mouse study, other researchers investigated the antimutagenic effects of the same mushroom. They concluded that antimutagenic activities of hime-matsutake, under certain circumstances, might contribute to its anticarcinogenic effect.

Umbrella Of Protection : The growing body of scientific evidence indicates that mushroom extracts and derivatives support the immune system. For wellness and general health effects, I recommend a combination of mushroom products (vs. a single mushroom type), preferably from an extract rather than an unprocessed whole mushroom. Certainly, incorporating whole mushrooms in the diet is important, but to achieve greater and more specific immune enhancement, standardized extracts are needed. A combination of different medicinal mushrooms offers both the generalized and specific immune system benefits. For example, a formula that includes some combination of reishi, shiitake, cordyceps, fuling, lion's mane, bai-mu-erh, and zhu-ling extracts can be taken frequently or even daily to enhance the immune system. As powerful immune modulators and potentiators, medicinal mushrooms are contraindicated for a number of autoimmune con

ditions such as systemic lupus erythematosus and collagen autoimmune disorders.

Medicinal mushrooms' value to human health is beginning to gain acceptance. Researchers are providing crucial data on the array of bioactive chemicals found within these fascinating fungi. More research is certainly warranted, but it appears mushrooms hold potential for improving human health and immunity.

Red Reishi (*Ganoderma lucidum*) - also known as Ling Chi. Reishi is used as a daily tonic to maintain and improve good health, increasing longevity, in the treatment of cancer and resistance to and recovery from diseases. Used daily, it maintains peak cellular immunity, improves liver and cardiovascular health, by reducing blood pressure, cholesterol and platelet aggregation. It is also used for hepatitis C, increasing oxygen absorption, and by mountain climbers to combat altitude sickness. CAUTION: Reishi can cause thinning of the blood and increased blood flow so women who menstruate heavily and persons going into surgery should use with caution. Since cooking with Reishi is not practical, we have listed some other ways to enjoy the health benefits:

Reishi Tea - Slice the dried mushroom and simmer in boiling water for 2-3 hours. Strain and add a little honey or fruit juice (to overcome the bitterness of Reishi). Can be stored in the refrigerator for up to three days. Drink hot or cold. Do not use aluminum or cast iron to prepare, store or serve Reishi Tea.

(Reishi Tonic) - slice about 1/2 ounce of dried Reishi add to a bottle of wine or brandy. Let stand for at least six weeks. Enjoy a small glass each day.

Reishi Soup - Simmer Reishi slices in your favorite soup for 2-3 hours. Adds an earthy flavor.

Shiitake (*Lentinula edodes*) - Shiitake is used to stimulate immune function, liver health and reducing cholesterol levels. It has been used for Hepatitis B and also seems to possess anti-viral properties. Shiitake activates killer and helper "T" cells.

Maitake (*Grifola frondosa*) - also known as Hen-of-the-Woods. Maitake is being used for many cancers including breast and prostate, HIV, chronic fatigue syndrome, diabetes, reduction in blood pressure and cholesterol levels. Studies at the National Cancer Institute have shown complete tumor regression in one-third to one-half of the trials.

Oyster Mushroom (*Pleurotus ostreatus*) - also known as Tree Oyster. This mushroom naturally produces Lovastatin, an FDA approved drug for the treatment of blood cholesterol. Animal studies have shown a 79.4% tumor inhibition rate against sarcoma 180 and a 89.7% inhibition rate against a mammary tumor system (MM-46). It totally negated increases in triglycerol levels and liver cholesterol resulting from chronic alcohol ingestion in hamsters.

Silver Ear (*Tremella fuciformis*) - also known as Snow Mushroom. Tremella is effective in treating leukopenia in cancer patients by radio- and chemotherapy. It also boosts immunological functions and stimulate leukocyte activity. It has been shown to improve immunity and resistance to chronic bronchitis. It has also shown to be very effective against hepatitis and tumors.

Himematsutake (*Agaricus blazei*) - also known as Congumelo do Sol. Quickly becoming the most important mushroom for its medical qualities, it contains the largest concentrations (up to 14%) of 1,3- and 1,6- beta glucans than any other mushroom. Its unique polysaccharides are selectively cytotoxic on tumor cells. An added benefit-it adds an almond flavor to culinary dishes.



Glyconutrients from Mushrooms

Medicinal mushroom extracts have been used as powerful immune-stimulators in Asia and more recently in the US, Europe and Canada. The primary phytochemical constituent associated with immune support based on research studies have been their polysaccharide components. The primary polysaccharide found in mushroom extracts is a beta-glucan, however, beta glucans and bovine colostrum have very different effects on the immune system than the biological sugars, it is a true immune modulator - controls or regulates immunity - while the beta glucans and colostrum are very potent immune stimulators.

Mushrooms are unique, stationary like a plant, yet built from chitin, the same material contained in the shell of a lobster. Understanding the properties of chitin is critical to understanding how to choose an effective, high-quality medicinal mushroom product.

Chitin is indigestible by humans. Yet chitin, which makes up the cell walls of mushrooms and mushroom mycelium, contains the potent immune stimulating compounds common to all medicinal mushrooms, the polysaccharides. Practitioners of Traditional East Asian Medicine and modern clinical researchers both use the same preparation technique to overcome this barrier, hot water.

Only a heated liquid solution can break down the indigestible chitin and release the active compounds into a concentrated, bio-available form. When used in Traditional Chinese Medicine for chronic conditions or immune health medicinal mushrooms are always prepared with heat and water, as a tea or a decoction. Medicinal mushrooms are never used in the un-extracted form (as mycelium bio-mass powder or dried mushroom powder), and rarely prepared as a tincture (soaked in alcohol and water in the absence of heat).

Scientific research backs this traditional preparation method. Every published, independent study on the use of medicinal mushrooms for immune health has been conducted with a hot water or hot water/alcohol extract. Every form of

extraction, including precipitation with alcohol, requires a heated liquid solution to first release the polysaccharides, the primary active compounds, from the chitinous cell walls of the mushroom and mushroom mycelium.

This is true for Reishi; *Coriolus versicolor*; Maitake; Shiitake; and Cordyceps. All of the well-known isolates are also extracted in a heated aqueous solution.

According to the American Herbal Pharmacopoeia mycelium bio-mass products are inferior because of a "lack of bio-availability". This publication also states that concentrates derived through proper extraction contain active compounds "magnitudes higher than what is available in crude mycelium biomass preparations". The cell wall extract from *Coriolus versicolor* has been clinically proven to stimulate and enhance the effectiveness of the bodies own natural defenses, a critically important step in the process of healing and maintaining good health.

Enhanced Immune Function :

In *Coriolus versicolor*, the polysaccharides are made up of a unique combination of amino acids and betaglacans. These polysaccharides are not affected by the digestive process.

Receptors for beta-glucans have been demonstrated to be on a number of different immune cells including natural killer cells and neutrophils, on monocytes/macrophages, and on T and B lymphocytes.

Coriolus polysaccharides have been shown to stimulate the antigen-presenting cell function of macrophages and, consequently to stimulate overall immune function,. Several studies have also reported the ability of *Coriolus* polysaccharides to enhance in vitro proliferation of T and B lymphocytes , and to enhance the cytotoxic activity of NK cells.

Recent U.S. research has confirmed these immunomodulating properties, specifically, these polysaccharides acted as a potent inducer of proliferation, tumor cytotoxicity, and lymphokine production by human lymphocytes in in vitro studies.

The clinical research conducted with *Coriolus* polysaccharides is extensive, and unique among medicinal mushrooms. No medicinal mushroom, or any other beta-glucan product, has been subjected to as many controlled studies as *Coriolus versicolor*.

The impact of the *Coriolus* polysaccharides on immune function was studied in patients in a randomized, controlled, clinical trial, after curative surgery for colon cancer. The follow up time was ten years. The researchers found that, when compared with the control group (surgery only), the leukocyte activity of the *Coriolus* group showed "remarkable enhancement".

It was concluded that "the beneficial effects were probably due to the activation of leukocyte functions as one of the many biological-response-modifying activities induced by (*Coriolus* polysaccharides)". This improvement of immune function was found to be significant when the disease free periods and the survival rate were more than doubled over that of the control group during the ten year period.

Mushroom Combined With Conventional Approaches :

Controlled clinical studies have also found the immuno-modulating properties of *Coriolus* polysaccharides to be effective in improving survival rates for those people using conventional cancer treatments through its ability to "inhibit disorders of cellular immunity attributed to anti-cancer drugs".

A five year study, published in Lancet, found that those patients receiving chemotherapy and *Coriolus* polysaccharides after curative surgery for gastric cancer experienced a significant improvement in survival rates, 73% vs. 60%, over the control group (surgery and chemotherapy only). Researchers found the *Coriolus* polysaccharides to have a "restorative effect in patients who have been immuno-suppressed by both recent surgery and subsequent chemotherapy."

Coriolus polysaccharides have also been studied for their immuno-restorative effect in those people receiving radiation treatment after surgery for non-small cell lung can

cer. This study found that the "five-year survival rate of the patients (who received *Coriolus* polysaccharides) with stages I or II disease, as well as stage III, was 39% and 22% respectively, compared with the non-administered groups' 16% and 5%. These differences are statistically significant." Stage III patients that received *Coriolus* polysaccharides along with radiation had a better survival rate than stage I patients receiving radiation alone (22% vs. 16%).

Analysis :

There are many chemically distinct extract products that can be produced from the mushroom *Coriolus versicolor*. It is the cell wall extracts that were used in Traditional Chinese Medicine, and it is these same compounds that form the basis of the modern clinical research.

Elemental Analysis;

Carbon.....	40.5%
Hydrogen.....	6.2%
Nitrogen.....	5.2%
Oxygen.....	47.5%

Content Analysis;

Soluble carbohydrate.....	34%-35%
	(91-93 % beta-glucan containing glucose polymer)
Protein.....	28%-35% (amino acids)
Moisture.....	7%-7.6%
Ash.....	6%-7% (carbon)
Remainder.....	Free Sugars and Amino Acids

Protein-Bound Polysaccharides :

Research with the mushroom *Coriolus versicolor* has found that the protein-bound polysaccharides with the beta-1,4, beta-1,3 , and beta-1,6 linkage are the primary active compounds. Chitin also contains the polysaccharides, the primary active compounds.



Excerpts from "Structure – activity Characterization, a quick method to screen mushrooms for the presence of anti-tumor glucans" By: Marcella Mascarenhas.

Published in "MUSHROOM RESEARCH" 1994, 2, 77-80

Abstract :

Several methods exist for cancer treatment in modern medicine. However all these methods prove harmful to the host systems. Hence more interest is being generated in conservative and harmless form of treatment particularly in Asian countries like China and Japan. These medicine also include the use of mushrooms for the treatment of several forms of cancer. Analysis of the compounds in mushrooms show that the high molecular weight glucans composed of glucose units linked in 1-3 and 1-6 linkages are responsible for antitumor activity. In the present investigation, structural elucidation of the glucans in mushroom extracts was found to be a quick method for screening and identifying antitumor activity in mushrooms. This is exemplified in the present investigation using the Chinese mushroom *Volvariella volvacea*.

Cancer is a dreaded disease known since antiquity. Several methods exist for the treatment in modern medicine which include chemotherapy, radiotherapy and surgery. This form of treatment is found to affect the host normal cells, hence more interest is being generated in conservative form of treatment namely homeopathy and ancient Indian medicinal system namely ayurvedic medicine. This trend is being increasingly observed in cancer treatment in Asian countries like China, Japan which is to return to ancient folk medicine. These medicines include the use of mushrooms also for the treatment of several forms of cancer.

Preliminary studies on the antitumor activity of mushrooms was carried out using *Lentinus edodes*; *Auricularia auricula*; *Volvariella volvacea* etc.

An analysis of structural features of the antitumor extract, shows that all the compounds responsible of antitumor activity in mushrooms were high molecular weight

glucans linked in 1-3 and 1-6 linkages that would provide solubility and antitumor activity. Further this has been confirmed using the Chinese mushroom *Volvariella volvacea*.

Glucans having antitumor activity differ greatly in their composition and physical structures. Antitumor activity appears to be possessed by a wide range of glucans extending from homopolymers such as glucans, mannans and glucomannans as found in mushrooms to highly complex glucans such as cellulose and hemicellulose as found in plants and bacterial lipopolysaccharides.

In general 1-3 Beta. D glucans with 1-6 linkages having a preponderance of 1-3 linkages with sufficient 1-6 linkage have been found to possess antitumor activity (Table)

Glucan	Source	Linkages
Lentinan	<i>Lentinus edodes</i>	(1-3)
Beta D		
Schizophyllan	<i>Schizophyllum commune</i>	(1-6)
Beta D		
Pachymaran	<i>Poria cocos</i>	(1-3)
Beta D		
Auricularia glucan	<i>Auricularia auricula</i>	(1-3)
Beta D		
Ganoderma glucan	<i>Ganoderma lucidum</i>	(1-3)
Beta D		
Agrocybe	<i>Agrocybe cylindrica</i>	(1-3)
Beta D		
Volvariella glucan	<i>Volvariella volvacea</i>	(1-3)
Beta D		

The glucan was extracted from *V. volvacea* and this purified molecule showed antitumor activity against the Sarcoma 180 tumor cells which shows that structure - activity characterization is a reliable method to identify antitumor glucans in mushrooms.



MUSHROOMS FOR MANKIND

Koeli Roy Burman

M.Sc part-II (BOTANY) N.B.U

Mushroom is one of the best natural health food. It is free from calories & rich in vegetable fibres. Mushroom has been recommended as supplementary food to the population of developing countries, whose food habit is cereal based lacking protein, vitamins & minerals. An important factor

MOISTURE	89.9%
PROTEIN	2.9%
FAT	0.36%
CARBOHYDRATE	5.3%
FIBRE	1.1%
ASH	1%
CALORIES	33.9%
THIAMINE	0.5mg
RIBOFLAVIN	0.5mg
NIACIN	10.9mg
Ca	3.3mg
P	134.8mg
Fe	1.5mg
Na	83.7mg
K	379.3mg

CHART NO. 1
GENERAL NUTRITIVE CONTENT

regarding mushroom is that protein & vitamin content of this food is well retained during preservation & even after cooking. It is important to mention that mushroom protein contains all the essential amino acids required by our body. It contains minerals & important vitamins like folic acid, cobalts, NH₃, Na, K & helps nerve co-ordina-

tion & ultra filtration in kidney.

Now if we consider the nutritive content of mushroom, in general we can find that it contains —
CHART NO.-1

And now if we go through

the protein content of mushroom & compare with vegetable

FOOD MATERIAL	PROTEIN[%]
OYSTER MUSHROOM	2.9
PEAS	2.6
CABBAGE	1.5
CARROT	1.1
CAULIFLOWER	2.7
POTATOES	2.1
APPLE	0.3
BANANA	1.1

CHART NO. 2
COMPARATIVE CHART WITH
VEGETABLES AND FRUITS

& fruits we can say that mushroom contain higher protein than other vegetables -CHART NO.-2

The comparative chart (3) of food value below is representing that dried mushrooms contains 39.40% protein,

	PROTEINS	FAT	MINERALS	CARBOHYDRATE
COW MILK	28.15	31.70	4.6	39.20
CHICKEN	42.75	41.75	3.2	6.43
MUTTON	40.75	39.58	2.7	-
SOYA BEAN	34.45	12.22	3.5	14.24
MUSHROOM[DRY]	39.40	6.5	9.5	6.25

CHART NO. 3
COMPARATIVE CHART OF FOOD VALUE

6.50% fat, 9.5% minerals & 6.25% carbohydrate.

These amounts are very much essential for our better health. In the mushroom world there are some mushrooms which are medicinally important e. g - *Lentinula edodes* known as Shiitake, *Ganoderma lucidum* know as Reishi, *Grifola frondosa* known as Maitake etc. The diseases against which these

NAME OF MUSHROOM	ACTIVITIES
1/Shiitake[<i>Lentinus edodes</i>]	Immune-modulating,Increases natural killer Cell action, Anti-viral,Liver-fortifying,Reduce total cholesterol level,Specifically reduce low-density Lipo-proteins and triglycerides,it contains poly saccharides LENTINAN which slows the growth of cancerous tumors , Extracts from Shiitake cure and prevents heart disease,cancer and AIDS, effective to treat Candida albicans.
2/Reshi[<i>Ganoderma lucidum</i>]	Anti-tumor,Immune-enhancing,Anti-viral,Cholesterol reducing and Anti fatigue, Nourish the nervous system, Strengthen the lungs, stimulate the liver, reduce insomnia,balances LDL/HDL ratio, It is specific for asthma,allergies,bronchitis.Several countries use this mushroom to treat cancer , AIDS, Chronicfatigue syndrome and detoxifies the liver.
3/Maitake[<i>Grifola frondosa</i>]	Anti tumor [especially breast and colorectal cancer] Anti-diabetic,Anti-viral,lowers blood pressure, reduces cholesterol and blood sugar, Boost immune system like natural killer cells, cytotoxic T cells, macrophages,superoxide anion cells and interleukin, it lowers the triglyceride levels and increases immunity in cells with HIV infection, AIDS and hepatitis- B.
4/Turkey tail [<i>Corio vericolor</i>]	Immune enhancement, Anti tumor , anti viral, anti bacterial, and anti oxidant.
5/ <i>Poria cocos</i>	It has been shown to have a relaxing effect on nervous system and smooth muscle, lower blood glucose, works as a good diuretic, strengthen the heart, reduce insomnia and forgetfulness.

Chemical Constituents & their activities

MUSHROOM	CHEMICAL-COMPONENTS	ACTIVITIES
1/Shiitake	Beta-glucan	Beta-glucan binds to macrophages and other phagocytes WBC at certain receptors and activates their anti-infection and anti-tumor activity by stimulating free radical production.
	Polysaccharide-lentinan	It slows down the growth of cancerous tumors in animals and enhances the immune system to fight infection.
	Activated Hexose	Reduce tumor activity
	Eritadenine	Lowers cholesterol by blocking the way cholesterol is absorbed into the blood stream.
2/Reshi	Branched polysaccharide protein complex	Rejuvenating the immunity of HIV infected cells.
	Tri-terpenes	These have a steroidal nature, working as hormonal communicators; have profound effect on subtle action in our body.
	N2 containing compounds like Adenosine	The amino acids are known to be building blocks of our basic cellular material of RNA, also being very important in our energy system with adenosine being the core of AMP and ATP.
3/Maitake	D-fraction [polysaccharide protein complex]	Responsible for immune modulating effect.

mushrooms are used are described in the chart (4) below. These medicinal mushrooms have some important chemical com-

pounds which acts against those diseases which are described in the previous chart. Name of the mushrooms, their chemical components & their activities are shown in this chart - 5

THIRD WORLD COUNTRY-SCENARIO

MALNUTRITION PROBLEMS:

- Chronic energy deficiency
- Kwashiorker
- Marasmus

MICRO-NUTRIENT DEFICIENCY:

- Goiter
- Beriberi
- Vitamin deficient blindness
- Anaemia

OTHER PROBLEMS

- Retarded growth
- Deficiency in IQ and work efficiency
- Prone to epidemic diseases

FOOD	USE PER HEAD	ICMR-PRESCRIBED FOR INDIANS	DEFICIENCY
MILK	216gm/day	250gm/day	34gm/day
EGG	30/year	180/year	150/year
MEAT	3.24kg/year	10.95kg/year	7.71kg/year

The third world country senario shows that there are some malnutrition problems, Mi-

cro-nutrient deficiency & other problems - ICMR has prescribed the amount of food for Indian but there are some deficiency which is shown in the chart below chart - 6.

To over come these problems some active steps has to be taken by the Universities, Govt. Departments, Doctors & N. G. O.S.

Glycaemic effects of traditional European plant treatments for diabetes. Studies in normal and streptozotocin diabetic mice

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Twelve plants used for the traditional treatment of diabetes mellitus in northern Europe were studied using normal and streptozotocin diabetic mice to evaluate effects on glucose homeostasis. The plants were administered in the diet (6.25% by weight) and/or as decoctions or infusions in place of drinking water, to coincide with the traditional method of preparation. Treatment for 28 days with preparations of burdock (*Arctium lappa*), cashew (*Anacardium occidentale*), dandelion (*Taraxacum officinale*), elder (*Sambucus nigra*), fenugreek (*Trigonella foenum-graecum*), guayusa (*Ilex guayusa*), hop (*Humulus lupulus*), nettle (*Urtica dioica*), cultivated mushroom (*Agaricus bisporus*), periwinkle (*Catharanthus roseus*), sage (*Salvia officinale*), and wild carrot (*Daucus carota*) did not affect the parameters of glucose homeostasis examined in normal mice (basal plasma glucose and insulin, glucose tolerance, insulin-induced hypoglycaemia and glycated haemoglobin). After administration of streptozotocin (200 mg/kg) burdock and nettle aggravated the diabetic condition, while cashew, dandelion, elder, fenugreek, hop, periwinkle, sage and wild carrot did not significantly affect the parameters of glucose homeostasis studied (basal glucose and insulin, insulin-induced hypoglycaemia, glycated haemoglobin and pancreatic insulin concentration). Guayusa and mushroom retarded the development of hyperglycaemia in streptozotocin diabetes and reduced the hyperphagia, polydipsia, body weight loss, and glycated haemoglobin. Mush

room also countered the initial reduction in plasma insulin and the reduction in pancreatic insulin concentration, and improved the hypoglycaemic effect of exogenous insulin. These studies suggest the presence of potentially useful antidiabetic agents in guayusa and mushroom.

Diabetes Res. 1989 Feb;10(2):69-73.



Anticancer and Hypoglycemic Effects of Polysaccharides in Edible and Medicinal Maitake Mushroom [*Grifola frondosa*]

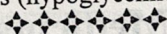
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ABSTRACT :

An investigation was carried out on the possible anticancer activity and hypoglycemic action of bioactive polysaccharides of Higher Basidiomycetes maitake mushroom [*Grifola frondosa* (Dicks.: Fr.) S. F. Gray], namely, D-fraction and SX-fraction, on human prostate cancer PC-3 cells in vitro and type 2 diabetic patients. D-fraction was highly cytotoxic to prostatic cancer PC-3 cells, inducing nearly complete cell death (>95%) in 24 hours. The combination of a low concentration of D-fraction (with no cytotoxic effect) and vitamin Ñ was also found to be as effective as D-fraction alone, suggesting a synergistic potentiation of D-fraction with vitamin C. An anticancer agent carmustine (BCNU), capable of

inducing a -50% reduction in cell viability by itself then showed its enhanced cytotoxicity with D-fraction resulting in a ~90% cell viability reduction. In clinical studies on hypoglycemic effect of SX-fraction, 5 patients with type 2 diabetes under oral medications demonstrated improved glycemic levels with *G. frondosa* polysaccharide caplets (MFCs) containing active SX-fraction. One patient showed complete glycemic control with MFCs and is currently free of medications, whereas others showed over 30% decline in their serum glucose levels with MFCs in 2 to 4 weeks. Therefore, polysaccharides of *G. frondosa* may have therapeutic implications in the effective treatments of prostate cancer (anticancer activity) and type 2 diabetes (hypoglycemic action).



Pleurotus

Medicinal Mushrooms

Mushrooms and Breast Cancer Research

The American Cancer Society warns that one in eight American women will be diagnosed with breast cancer in her lifetime. Studies underway at the Beckman Research Institute of the City of Hope in Duarte, California, suggest that fresh white mushrooms (*Agaricus bisporus*) contain substances that inhibit activity of aromatase, an enzyme used in production of estrogen, believed to have breast cancer-promoting effects in post-menopausal women.

Initially, extracts from seven vegetables green-onion, celery, carrot, bell pepper, broccoli, spinach and mushroom--were tested for aromatase-inhibiting activity. The most effective aromatase inhibitor was found in white mushrooms. The study's second phase tested only mushrooms to learn whether other varieties contain the aromatase inhibitor. It included portabellas, shiitake, crimini (brown), oyster, enoki, wood ear, chanterelle, small white and large white (stuffing) mushrooms. The large white mushrooms emerged as the most potent inhibitor of aromatase activity. Other members of the *Agaricus family*--portabellas, crimini and small whites--also demonstrated significant anti-aromatase effects.

Lead researcher Shiuan Chen, Ph.D., says that several compounds in the mushrooms are probably responsible for the effect. Dr. Chen explains that, while his research looks promising, it's too early to tell whether the results can be replicated in humans or even animals. He and his colleagues begin tests with mice later this year.

Mushrooms and Prostate Cancer Research

Ongoing research suggests that selenium, working with its partner Vitamin E to scavenge cell-damaging free radicals, may help prevent prostate cancer, the second most common cancer in men after skin cancer. Last year, at least

31,000 deaths were attributed to the disease.

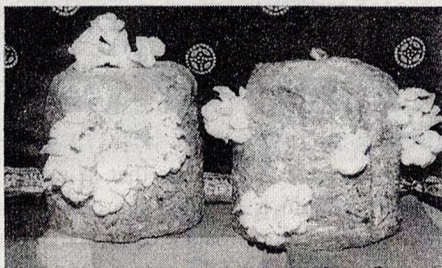
When it comes to selenium content, mushrooms surpass all other items in the produce category. A serving of crimini, in fact, provides one-third the Daily Value for selenium. Portabellas and white mushrooms are also good selenium sources. With their significant dose of selenium in every serving, mushrooms may turn out to be important ingredients in a cancer-fighting diet.

Selenium came to the forefront of prostate cancer research when in 1996, skin cancer patients were given selenium to learn whether it would prevent recurrence. It had no effect on skin cancer, but researchers noticed that it did decrease prostate cancer by more than 60%, which prompted further study.

Findings from the Baltimore Longitudinal Study on Aging found that men with the lowest blood selenium levels were four to five times more likely to have prostate cancer as those with the highest selenium levels. Furthermore, blood selenium levels appear to decrease with age, suggesting that older men should get more selenium in their diets.

The National Cancer Institute and the Southwest Oncology Group launched a 12-year study last year. Dubbed SELECT--the Selenium and Vitamin E Cancer Prevention Trial--the study will follow 32,000 men at 400 sites across North America to learn how selenium and Vitamin E work to protect against prostate cancer.

Courtesy : Samrat Mitra



Medicinal Mushrooms

Help yourself to a serving of health

Mushrooms, provide a wealth of protein, fiber, B vitamins, and vitamin C, as well as calcium and other minerals. and at least three species have demonstrated phenomenal healing potential: maitake, shiitake, and reishi. These medicinal mushrooms have been shown to boost heart health ; lower the risk of cancer; promote immune function; ward off viruses, bacteria, and fungi, reduce inflammation ; combat allergies; help balance blood sugar levels; and support the body's detoxification mechanisms.

Harriet Beinfield, acupuncturist and co-author of *Between Heaven and Earth : A Guide to Chinese Medicine*, explains: "the movement began with healthy food in the late '60s, now it's health medicine. People are interested in medicinal mushrooms because they've been used effectively for thousands of years."

Maitake: Fights cancer, balances blood sugar

Maitake (*Grifola frondosa*) means "dancing mushroom" in Japanese. Many doctors in Japan use maitake to lower blood pressure and blood lipids, key risk factors in cardiovascular disease. But maitake may best be known for its cancer-fighting properties. It contains grifolan, an important betaglucan polysaccharide (Molecule composed of many sugar molecules linked together). Grifolan has been shown to activate macrophages, a type of cell considered the "heavy artillery" : of the immune system , explains Larry A. Walker, Ph.D, R.D., author of "Natural products update," published in *Drug Topics*, June 1997. D-fraction, one of the polysaccharides in maitake, also energized the cellular immune system.

The evidence confirming maitake's therapeutic value - both in and out of the laboratory - is impressive Laboratory

studies have shown that maitake extract can block the growth of tumors and boost the immune function of mice with cancer. Haroaki Nanba reported the findings of the following study in "Maitake D-fraction: healing and preventing potentials for cancer," published in the Townsend Letter for Doctors and Patients, Feb/Mar 1996; In a non-randomized clinical study, 165 individuals with advanced cancer used maitake D-fraction. Patients received either maitake D-fraction alone or with chemotherapy. Maitake was found effective against leukemia and stomach and bone cancers. Responses were further improved when maitake D-fraction and chemotherapy were used together. Individuals receiving maitake D-fraction also experienced relief from the side effects of chemotherapy, such as loss of appetite, vomiting, nausea, hair loss, and deficiency of white blood cells.

People with non-insulin-dependent diabetes mellitus (NIDDM) may also benefit from maitake, according to researchers Hiroaki Nanda and Keiko Kubo, authors of "Mushroom biology and mushroom products". Researchers investigated a specific, high-molecular polysaccharide in maitake called the X-fraction. They found that mice given maitake had an increased ability to recognize glucose, and the control group had higher blood glucose levels. The researchers suggested that maitake can reduce insulin resistance, thereby increasing insulin sensitivity. The X-fraction appears to be the active compound with anti-diabetic properties.

Beinfeld also recommends maitake for stomach ailments. "It aids digestion by regulating the stomach and intestines, and helps eliminate food stagnation," she explains.

Shiitake : Lowers cholesterol , combats viruses

Shiitake mushrooms (*Lentinula edodes*) have been a mainstay of Chinese medicine for thousands of years. As far back as the 14th century, Chinese physician Wu-Rui described shiitake as a food that activates "Qi". Roughly translated, qi is the circulating life force, a function of which is to protect

the immune system. The ancient Chinese believed that shiitake dispelled hunger, treated colds, and nourished the blood circulatory system. Scientists today are finding that shiitake can help the body combat heart disease, cancer, and viruses.

Research conducted in Japan in the 1970s identified a specific amino acid in shiitake that helps speed up the processing of cholesterol in the liver. In a 1974 study (reported by Kenneth Jones in "Shiitake Medicine in a mushroom," Herbs for Health, Jan/Feb 1997), 40 elderly individuals and 420 young women consumed nine grams of dried shiitake or the equivalent amount of fresh shiitake (90g) every day for 7 days. After a week, total cholesterol levels had dropped seven to 15% in the older group, and 6 to 12% in the young women. Like maitake, shiitake also appears to be a formidable cancer fighter. In 1969, scientists at Tokyo's National Center Research Institute isolated a polysaccharide compound from shiitake they called lentinan. In laboratory trials, lentinan caused tumors in mice to regress or vanish in 80 to 100% of the subjects. Lentinan appears to stimulate immune-system cells to clear the body of tumor cells.

What's more, shiitake appears to be effective against some of the more serious viruses we face today: HIV and hepatitis B. Test-tube studies in Japan indicate that LEM (short of *Lentinula edodes mycelium*), an extract of shiitake mushroom, is more lethal to HIV infected cells than AZT, a well-known medication developed to delay the progress of AIDS. In other test-tube studies, LEM lignins have been shown to block HIV cells from reproducing and damaging helpful T cells. These lignins also stop cell damage from herpes simplex I and II, two viral infections that often plague individuals with HIV. Hepatitis B is a liver disease transmitted through transfusions, the use of unclean needles, or other blood-to-blood contact. In the 1980s, a trial involving 16 clinics in Japan investigated the impact of LEM on hepatitis B. The studies indicated that LEM may stimulate the body to produce antibodies. Forty individuals with chronic hepatitis B ingested six

grams of LEM daily for four months. All of the patients experienced relief of hepatitis B symptoms, and in 15, the virus was inactivated.

Beinfield points out that shiitake "can be used as a food as well as a medicine. It treats nutritional deficiencies and improves immunity through diet". Because of its appealing flavor and rich nutritional makeup, vegetarians sometimes use shiitake mushrooms as a substitute for animal protein.

Reishi : Good for Respiratory and Spiritual Health

Reishi (*Ganoderma lucidum*) has a dark, reddish-orange cap. The Latin word *lucidum* means "shiny" or "brilliant", and refers to the varnished surface of the reishi cap. From four millenia, the Chinese and Japanese have used reishi as a medicine for liver disorders, hypertension, and arthritis. Through in vitro and human studies, today's researchers have found that reishi has anti-allergic, anti-inflammatory, antiviral, anti-bacterial, and antioxidant properties. In vitro experiments also indicate that reishi may help fight tumors. In addition, a protein isolated from reishi- Ling Zhi-8-may reduce the risk of transplant rejection.

Beinfield point out that reishi is particularly beneficial for individuals with asthma and other respiratory complaints. "It has a healing effect on the lungs," she says. "Reishi is good for respiratory strength and for coughing". At least one population study confirms this claim. When more than 2000 Chinese with chronic bronchitis took reishi syrup during the 1970s, within two weeks, 60 to 90% felt better and reported an improved appetite, according to "Medicinal mushrooms," by Christopher Hobbs, published in *Herbs for Health*, Jan/Feb 97.

Reishi also has non-material benefits. Beinfield explains, "Reishi is said to elevate the spirit, it's a mood-elevating substance." Traditionally, reishi is believed to help transform the individual into a more spiritual being. Just as mushrooms transform decayed material on the ground into life-

giving nourishment, reishi converts metabolic and psychic wastes (hostility and other negative feelings), thereby raising the spirit and unshackling the mind. Individuals can consume reishi every day to support immune function, peace of mind, and physical vigor. Reishi is available in syrups, soups, teas, tinctures, tablets, and by injection. Form and dosage should be decided with the help of a healthcare professional.

Final Words

Maitake, shiitake, and reishi mushrooms have many overlapping properties: all boost immune function, all support cardiovascular health, and all show promise in lowering the risk of - or treating - cancer. However, maitake is specifically recommended for the stomach and intestines, as well as blood sugar levels; shiitake treats nutritional deficiencies and liver ailments; and reishi promotes respiratory health and spirituality.

Medicinal mushrooms offer both dietary and therapeutic benefits. As natural medicines, maitake, shiitake, and reishi are like to become a staple in the natural medicine of tomorrow, as they have in the past.



Volvariella

“মাশরুম চিনুন, মাশরুম খান, মাশরুম খাওয়ান”

ঋতা গাঙ্গুলী, সংযোজিকা

ওয়েস্টবেঙ্গল এডিবল্ মাশরুম কাল্টিভেটরস
এন্ড স্পন্স মেকারস্ এ্যাসোসিয়েশন
কলকাতা - ৩৮

মানুষের দৈনন্দিন খাদ্য তালিকায় মাশরুমের অপরিহার্য উপস্থিতির জন্য প্রয়োজন শরীরের সঠিক পুষ্টির পরিমাপ এবং তার মধ্যে মাশরুমের স্থান কোথায়, ও কেন, সে ব্যাপারে গণ-সচেতনতা এবং প্রচার।

সুস্থ শরীর গঠনের জন্য চাই সুস্বাদু, কিন্তু স্বাস্থ্যকর ও পুষ্টিকর খাদ্য। সঠিক পুষ্টির পরিমাণ দৈনন্দিন খাদ্যের উপাদানের উপর নির্ভরশীল। দৈনিক খাবারে শক্তির ও প্রোটিনের যথাযথ উপস্থিতি শরীরের গঠন ও কর্মক্ষমতা বজায় রাখে। শক্তি অর্থাৎ ক্যালরির যোগান দেয় ফ্যাট ও কার্বোহাইড্রেট জাতীয় খাদ্য। দৈনিক খাবারে ধারাবাহিকভাবে শক্তির ঘাটতি অপুষ্টি - জনিত রোগ সৃষ্টি করে। অপরদিকে বয়স্ক মানুষের ক্ষেত্রে যাঁরা দৈহিক শ্রমসাধ্য কাজ কম করেন, বিশেষ করে ডায়াবেটিক ও হৃদরোগীদের ক্ষেত্রে কম ক্যালরিয়ুক্ত খাওয়া প্রয়োজনীয়। মাশরুমে ফ্যাট ও কার্বোহাইড্রেট খুবই কম, ফলে ক্যালরি যোগানও কম। সেই কারণে মেদ বাহুল্য প্রতিরোধে, ডায়াবেটিক ও হৃদরোগীদের খাদ্য তালিকায় মাশরুম থাকা খুবই প্রয়োজনীয়।

প্রোটিন আমাদের শরীর গঠন ও রক্ষণের জন্য প্রয়োজনীয়। প্রোটিনে থাকে নানা ধরনের এ্যামিনো অ্যাসিড, যার মধ্যে কিছু অপরিহার্য এ্যামিনো অ্যাসিড উদ্ভিজ্জ প্রোটিনে কম থাকে। প্রাণীজ প্রোটিনে প্রায় সবগুলিই থাকে। মাশরুমের প্রোটিনে অপরিহার্য এ্যামিনো অ্যাসিডগুলিই থাকে যা সহজ পাচ্য, ফলে গৃহিত প্রোটিন শারীরিক কাজ কর্মে দ্রুত সহায়ক হয়। প্রোটিনের বিচারে নিরামিষ ভোজীদের জন্যও মাশরুম বিশেষভাবে উপযোগী।

সুস্থ থাকার জন্য দৈনিক খাবারে প্রয়োজন খাদ্য প্রাণ বা ভাইটামিন, মিনারেলস্ ও আঁশ জাতীয় উপাদান বা ফাইবারের উপযুক্ত মাত্রায় উপস্থিতি মাশরুমে কয়েকটি মূল্যবান খনিজ লবন বা মিনারেলস্ থাকে যা হাড় গঠনে ও দাঁত মজবুত করতে বিশেষ সাহায্য করে।

মাশরুমে ভিটামিনও পর্যাপ্ত পরিমাণে থাকে - বিশেষ করে বি

ভিটামিন, ফলিক অ্যাসিড যা রক্তাল্পতা রোগীর পক্ষে বিশেষ উপযোগী।

গ্রাম বাংলার দিকে নজর দিলে দেখা যায় প্রাকৃতিক এবং অর্থনৈতিক বিবিধ সমস্যার ফলে গ্রামবাসীরা প্রায়ই অপুষ্টিজনিত রোগে ভোগে। এর ফলে তাদের কর্মক্ষমতা কমে যায়, ও তারা সহজেই নানারকম অসুখের শিকার হয়। শুধুমাত্র গ্রামই নয় - শহরেও যথাযথ শিক্ষা ও সচেতনতার অভাবে সুখম খাদ্যাভ্যাস গড়ে উঠছে না। এই অপুষ্টির মোকাবিলার জন্য প্রয়োজন এমন ব্যবস্থা যাতে একজন ব্যক্তি (গ্রাম বা শহরে যেখানেই থাকুন) সহজেই সুখম পুষ্টিকর খাদ্য পেয়ে যান এবং তার গ্রহণ যোগ্যতা সম্বন্ধে যথাযথ জ্ঞান থাকে। এ ক্ষেত্রে মাশরুমকে সহজেই একটি সুখম খাদ্য হিসাবে গ্রহণ করা যায়, যার মধ্যে ক্যালরি কম, প্রোটিন বেশি, গ্র্যামাইনো অ্যাসিডে সমৃদ্ধ ও রোগ প্রতিরোধকারী ভাইটামিন ও মিনারেলস-এ পূর্ণ। যতদিন পর্যন্ত সুখম পুষ্টিকর খাদ্য সম্বন্ধে সাধারণ মানুষের সচেতনতা বৃদ্ধি পাবে না, ততদিন পর্যন্ত মাশরুম তাদের দৈনন্দিন খাদ্যতালিকার বাইরেই থেকে যাবে।

বর্তমানে বিভিন্ন পত্র পত্রিকায় মাশরুমের গুণাবলী, সহজ চাষ পদ্ধতি, বিভিন্ন রান্নার পাকপ্রণালী প্রভৃতি তথ্য সাধারণ মানুষদের কাছে বিস্তৃতভাবে পরিবেশন করা হয়। কিন্তু আমাদের সংখ্যাগরিষ্ঠ দেশবাসীর মনে আজও মাশরুম সম্বন্ধে যে বদ্ধমূল বিভিন্ন কুসংস্কার প্রোদিত আছে, তা দূর করে মাশরুমের গ্রহণ যোগ্যতা বৃদ্ধির জন্য যে প্রচার প্রয়োজন তা সেভাবে বিভিন্ন গণ মাধ্যমে এই সচেতনতা বৃদ্ধির জন্যে নিরন্তর সর্বস্তরে প্রচার খুবই জরুরী - যার দ্বারা মানুষের মনের অন্ধ ও ভুল বিশ্বাসগুলি ভেঙে দিয়ে মাশরুমকে আলু - পটল - মাছ - ডিম - সজ্জি প্রভৃতির মতোই সর্বসাধারণের নিত্য ব্যবহার্য আনাজ হিসাবে প্রতিষ্ঠিত করবে। মাশরুম শুধুমাত্র উচ্চবিত্তদের খাবারেই বৈচিত্র্য আনে না, সাধারণ মধ্যবিত্তদেরও দৈনন্দিন খাদ্য তালিকায় নিজগুণে জায়গা করে নিতে পারে। আজ মাছ - মাংসের দাম আকাশ ছোঁয়া এবং তারও সরবরাহ সবসময়ে নিয়মিত নয়, বিকল্প সহযোগী পুষ্টিকর খাদ্য হিসাবে মাশরুম, মাছ - মাংসের অভাবটা সহজে ও সস্তায় পূরণ করে উঠতে পারবে। গ্রামীণ পরিবেশে সহজে (কম খরচে) এবং সুলভে পুষ্টিকর ও স্বাস্থ্যকর খাদ্য হিসাবে মাশরুমের চাষ অতি অবশ্যই বৃদ্ধি করা প্রয়োজন। মাশরুম পরিবারের সকলের সুস্থাস্থ্যের দায়িত্বই শুধু নয়, চাষীদের অর্থনৈতিক সাফল্যেরও দিশারী হতে পারে।

অতএব উপসংহারে এটুকুই আবার জানানই অপরিহার্য সুস্বাদু ও পুষ্টিকর খাদ্য হিসাবে “মাশরুম চিনুন, মাশরুম খান, মাশরুম খাওয়ান।”

Nutritional value of Higher Fungi

Sharmistha Mazumdar M.Sc. B.Ed

Many of the reports in the literature on the nutritional value of higher fungi are contradictory Ramsholtam has suggested that this is due to the different ages of the specimens examined and to the practice of reporting on different species under a common heading. Since 50% of the present world population receive a sufficient bulk of food but lack essential constituents in the diet, notably certain amino acids and vitamins, So some of these essential requirement could be obtained from the higher fungi if palatable , Mycelium containing essential amino acids and vitamins could be produced in submerged culture on large scale.

Proteins and amino acids : The most extensive investigations have been made of the cultivated mushroom *A. campestris*. Fitzpatrick, Esselsen and Wier carried out feeding trials with the sporophoros of *A. campestris* and analysed the protein quantitatively for amino acids. The essential amino acids Phenylalanine, Histidine, Leucine, Lycine, Arginin, Tryptophan & Threonine were detected. The presence of Valine, Isolencine & Methionine was indicated by animal feeding trials and this indication was confirmed by microbiological assay method. Microbiological assay of the amino acids showed that Tryptophan was present in relatively small quantities. It was also found that purified proteins of *A. campestris* contained 11.79% of nitrogen. Chromatrography :- (Casimir & Heinemann analysed the mycelium of *A. campestris* and by paper chromatography detected appreciable quantities of Threonine, Lysine, Valine / Methionine, Leucin/ Phenylalanine and Histidine/ Arginine, Casimir & Renard analysed the proteins of 20 sps of Agaricales by paper Chromatography. Quantitative amino acid analysis of the proteins from several species of higher fungi have been made by Seelkopf and Schuster. Each of the sps. studied contained all the essential amino acids with the exception of *T. brumale* which lacked Methionine. Biological value It was concluded that the bio

logical values of the proteins of the species examined are between those of animal & vegetable proteins. Most of the sps. contained relatively small amounts of Methionine & Isoleucine.

The essential amino acids :- Histidine, Arginine, Valine, Leucine, Phenylalanine, Threonine and Lysine were found in appreciable amounts in the sporophores of *Volvaria volvacea* by Orillo & Carangal. Bano & his co - workers have reported that a *Pleurotus* sps. eaten by majority of the people in India can be cultivated on rice straw, it contains 2.78% of proteins. Quantitative amino acid analyses of the protein show that when compared with the proportions of the essential amino acids required for satisfactory growth of human beings, only Phenylalanine & Methionine are deficient.

Vitamins : More relative analyses of the cultivated mushroom *A. campestris* show that it is one of the best plant sources of nicotinic acid and riboflavin. Anderton & Feller assayed a number of vitamins in fresh mushroom. No vitamins A, D or E were detected although existence of the presence of Vitamin K (Mthy / phyty / naphthoquinone) was obtained. Ascorbic acid & the vitamin B Thianine, Riboflavin (B2) Nicotinic acid Pantothenic (B3) acid and Biotin (H) were estimated quantitatively. They concluded that sporophores of *A. campestris* are an excellent source of Pantothenic acid and a fair source vitamins B, C & K. They calculated that 100 gm. of fresh mushroom would provide approx 1/5 th of the daily requirement of Riboflavin & 1/4th of the daily requirement of Nicotinic acid, Riboflavin, Pantothenic acid, Biotin & Thiamine were well retained during cooking, canning, drying & freezing. Although Sumi found ergosterol to be present in several species of Japanese mushroom in, concentration ranging upto 0.4% of dry wt. Vit. D has been reported only in few sps. The following values is i.u /100 gms are among the few reported in the literature. *B. edulis* 83, *Cantharellus cibarius* 83, *Gyromitra esculenta* 112, *Psalliota campestris* grown in the dark 12, grown in the light 62.

Willstaedt determined the amounts of Thiamine and

Riboflavin in 1 or 2 edible sps. of higher fungi. *Lactarius deliciosus*, *Psalliota sylvatica*, *C. cibarius*, *Boletus lutens*, *T. nudum* contain 160 - 690 mg Riboflavin / 100gm.

More recent analyses have shown that quite large amounts of tocopherol occur in Mushrooms and the pattern of their composition is the same as that found in cereals. On the basis of dry weight some of the higher fungi have been shown to contain as much tocopherols as fresh lettuce leaves, which are usually regarded as a good source of vitamins.

Carbohydrates and lipids :- Little information is available for the fat content of different species of higher fungi. Hughes has identified linoleic acid as the main fatty acid components of *A. campestris* sporophores.

Ramshottom summarizes the fat content of 10 different well known edible species, reporting that the fat content of the fresh sporophores varied between 0.20 to 0.76%. The fat content of cultivated mushrooms have been estimated by Anderson & Fellus to be 0.19%. The lecithin & various sterols have been found in number of sps. The fat content varies according to the size of the part of the fruiting structure examined. In *Boletus edulis* 4.4% fat was found in the stipe, 8% in the hymenium & 5.8% in the upper parts of the pileus.

The values of carbohydrate content on a dry weight basis of a number of sps. of higher fungi vary from 28% in *Lactarius deliciosus* to 76% in *Armillaria mellea*. The main components were mannitol Glycogen & hemicellulose together with small amount of reducing sugars. Mannitol has been reported as being a frequent constituent of higher fungi and these reports have been confirmed by Paris, Durand & Bonnet who detected sugar alcohol in a large number of different sps. The sugar alcohol like Sorbitol & Erythritol also occur in higher fungi. *A. mellea* contain 13% Erythritol.

Trehalose is the only disaccharide to be formed free in appreciable amounts by fungi and it is especially common in Basidiomycetes. The carbohydrate composition of higher fungi varies with the age of the specimen examined.

Nutritional value of Mycelium grown in Submerged culture. :- It is source of proteins, vitamins that the mycelium of higher fungi could become a valuable addition to the world's food supply. A few sps. have been investigated in more detail and it has been shown that the protein content can vary considerably according to the media and growth conditions used. The values for the protein content of the mycelium of *Tricholoma nudum* have been shown to vary from 15% to 57.8% . The quantity of protein however depends on the proportions of essential amino acid present, characteristic of sps. and does not vary with the media.

Humfeld determined the proteins, fat and ash content of the mycelium of *A. campestris* produced in submerged culture.

Quantitative estimation of five vitamins in the mycelium of *A. campestris* were made by Humfeld & Sugihara. Only trace of VitC and carotene are found.

It has been found that the protein content of the mycelium dependent upon both the type & amount of the N_2 source. Reusser, Spencer and Sallans have reported the highest value for the protein content of *A. campestris* mycelium.

The amount of protein in the mycelium obtained varied with the cultured and the medium used for growth. The protein content of *T. nudum* were as follows : in synthetic medium (15%) in molasses medium (54.4%) and in waste sulphite liquor (38.7%) *Collybia velutipes* mycelium contained 53.5% protein when grown in an synthetic medium.

It has been found that the protein of the mycelium of *Morchella hortensis*, *Polyporus palustris* contained some 17 amino acids.

Analysis of the mycelium of Morel mushrooms *Morchella crassipes*, *M. esculenta* & *M. hortensis* show that proteins content varied from 22.8 to 51% and the fat content from 2.18 to 7.55% . The mycelium contains more Thiamine, Niacin, Pyridoxine, Pantothenic acid & folic acid. Riboflavin & Biotin were present in lower concentration.

Uses of Fungi

There are numerous ways in daily life that people are directly or indirectly concerned with fungi. Scarcely a day passes during which all of us are not benefited or harmed by them in some way or the other. Some fungi are prized for their usefulness directly or indirectly to the society whilst many are shunned for causing great harm to both plants and animals including man. The followings are some of the usefulness of fungi.

1. Food :- Certain Fungi like mushrooms, morels and truffles are used as food in most of the western countries. Mushrooms (*Agaricus*) have been used as food by man since ancient time, but not until the 17th century they were cultivated as a crop. The early cultivation of mushrooms took place in France.

About 200 sps of mushrooms are found to be edible. Of these, only few are cultivated. *Agaricus campestris*, *A. bispora*, *Lentinus edodus*, *Volvariella volvacea* are commonly cultivated in the different parts of the world.

Mushrooms are tasty, possess fine flavour & are of high nutritive value. They contain 51% of proteins, more than any vegetables & fruits.

Other constituents found in mushrooms, are Nicotinic acid, riboflavin, Pantothenic acid, Vit B, C, K, minerals, lipids & folic acid. *Collybia velutipes* is a common winter mushroom of western countries.

The genus *Morchella* (morels) is rather well known as an edible fungus. *Tuber* (truffles) already earned a fame for its taste, delicacy of flavour. Immature fruit bodies of lycoperdon, commonly known as puff ball fungus are also edible. The young maize cob tumours formed as a result of localized infection induced by *Ustilago maydis* forms a popular dish.

Yeasts contain a complete protein, consisting of a number of free amino acids, besides fats, minerals salts, vitamins etc. Yeasts are utilised by man, cattle, sheep, horses

either directly or indirectly. The large scale production of yeast as food is known as 'Microbial farming' (Yin 1949) may help to solve food problem to some extent.

2. Soil Fertility :- Majority of the known fungi with bacteria live on dead organic matters, decompose them thus increases the fertility of a soil. Some fungi can produce ammonia from proteins and thus play important role in nitrogen cycle.

3. Essential for various Industries :- Fungi are used in various kinds of industries like, brewing, baking, cheese industries and also in the production of organic acids, vitamins etc.

1. Alcohol industry Fungi, especially yeasts are regularly used for the preparation of alcoholic beverages. *Saccharomyces cerevisiae* are mainly used in the preparation of alcohols. *Aspergillus oryzae* is used in the manufacture of beer.

2. Cheese industry Cheese is a solid or semi solid protein product manufactured from milk. Several microorganisms seemed to be involved in the ripening process of cheese. Species of *Aspergillus* & *Penicillium* are mostly used.

3. Baking industry The importance of Yeasts in baking breads is well known. The dough for making breads is raised by the activities of yeasts. The raising of dough is caused by the evolution of CO_2 gas that makes the bread soft and porous and give it the desirable taste & texture.

4. Organic acids - a) Galic acids - Van Tieghem (1867) first discovered that *Aspergillus* & *Penicillium* are responsible for the production of Gallic acid. Gallic acid is prepared from tanin by the process of fungus fermentation. Gallic acid is used in the preparation of gallocyanin, blue dye, black inks, pyrogallol used for skin therapy.

b) Citric acid In 1893 Wehmer first synthesised Citric acid with the help of *Penicillium*. Now a days various species of different fungi have been used to synthesis citric acid, e.g. *Aspergillus carbonarius*, *A. glauca*, *Penicillium olivaceum*,

P. glaucum, *Mucor griformis*, citric acid is used as flavouring agent for confectionary, soft drinks, medicines & in silvering mirrors.

c) Gluconic acid Molliard (1922) synthesized gluconic acid, and citric acid from *Aspergillus niger*. Presently the said organic acid is obtained from *Aspergillus fuscus*, *A. oryzae*, *Penicillium glabrum*, *P. glaucum*. Apart from this, *Mucor* & *Monila* are also used as gluconic acid synthesizing agent. It is used in the preparation of tooth paste & calcium salt of gluconic acid is used as a source of calcium during pregnancy.

d) Haconic acid Obtained from *Aspergillus itaconicus*. This acid is valuable in plastic industry, glass industry, Jewellery etc.

e) Kojic acid Saito (1907) first extracted this acid from *Aspergillus oryzae*. Presently it is used in the preparation of several chemicals like ethers, Pyridines, pyridones etc.

f) Glycerol - *Zygosaccharomyces acidifaciens*, *Saccharomyces rouxii*, *S.mellis* are common to produce glycerol. Glycerol is useful in the production of rubber, tanin, alkaloid, thymol, adhesive, anti freeze etc.

g) Enzymes - A number of enzymes are produced by fungi, which are - i) Invertase from *Saccharomyces cerevisiae*. It is useful in the preparation of chocolate coated candies, in paper industry.

ii) Amylase from *Aspergillus oryzae*, used in alcoholic industry.

iii) Pectinase by *Penicilium glaucum*.

Growth promoting substance - Gibberelic acid is produced by *Gibberella fujikuroi* used to accelerate growth of several horticultural crops.

Fungi in Medicine - Some metabolites of fungi are used as medicines _

a) Ergot - The sclerotial stage of *Claviceps purpurea* is commonly called as ergot. Different alkaloids have been isolated from ergot, which are mainly used in controlling

haemorrhage after child birth.

b) Antibiotics - Different antibiotics have been isolated from fungus, some are

i) Aureomycin - *Streptomyces aurofaciens*.

ii) Citrinin - *Penicillium citrinum*

iii) Clavacin - *Aspergillus clavatus*

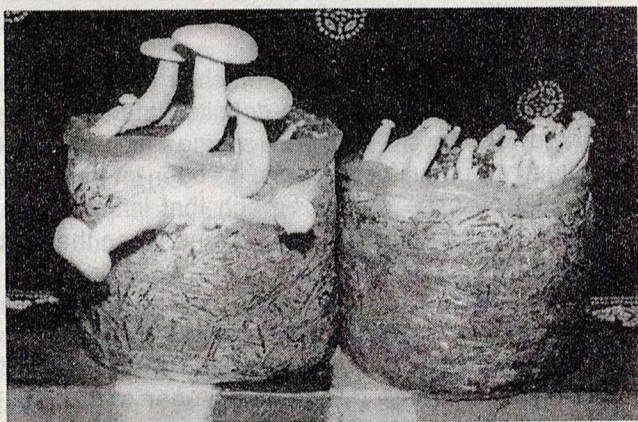
iv) Penicillin - *Penicillium notatum*, *P. chrysogenum*

v) Streptomycin - *Streptomyces griseus* etc.

c) Vitamins The yeasts are the best sources of vitamin B. Biotin, Pantothenic acid, Pyridoxin, Riboflavin, Thiamin are common examples of vitamins obtained from fungi.

d) Therapeutic uses of yeast According to Rhoads & others (1941) Yeast in regular diet reduces diabetes, & prevent the disease of cancer.

Thus it can be concluded that even though fungi cause many harmful effects to man & different useful plants, but their beneficial activities are also not negligible.



Calocybe

Medicinal Mushrooms Come Out of the Dark

Vicky Uhland

From The July 2003 Issue of *Natural Foods*
Merchandise

When most Americans think of mushrooms, they envision "that button mushroom you have on your pizza or your salad," says Clover Burns, sales and marketing administrator with The Tradeworks Group in Brattleboro.

Tradeworks contracts with inventors and researchers to market their products. One of Tradeworks' top sellers is Maitake Gold 404, a medicinal mushroom extract developed by a researcher from Kobe Pharmaceutical University in Japan. Tradeworks has marketed Maitake Gold 404 in the United States for about a year and a half. Initially, Burns says, selling the product entailed a "huge education process" about the many different types of mushrooms and their medicinal properties.

"But there's been a much greater awareness in the last year. The word is definitely starting to get out there," she says. "People are asking a lot more intelligent questions about mushrooms. It's been interesting to see it take off once people broach that initial information hurdle about medicinal mushrooms. Then they get very enthusiastic."

Mushrooms have been used as a cure-all in Asia for thousands of years, says Deanne Tenney, author of *Medicinal Mushrooms* (Woodland Publishing, 1997). "Polysaccharides [long-chain sugar molecules] are thought to be one of the constituents in mushrooms responsible for their medicinal abilities," Tenney writes. "These polysaccharides are able to stimulate the immune response against viral and bacterial diseases. They may even help with life-threatening diseases such as cancer,

cardiovascular disease, HIV, free-radical damage, liver problems and immune-related conditions.”

In addition, notes certified nutrition specialist Kristin Schierenbeck, “Medicinal mushrooms are considered a functional food and are considered safe.” Schierenbeck is technical sales manager at Quality of Life Labs, distributor of AHCC mushroom extract.

There are hundreds of mushroom varieties, ranging from exotic food fungi to hallucinogenics. But in the United States and Europe, only about 10 types of mushrooms are used medicinally, says David Law, president of I.G. International, a Sebastopol, Calif., mushroom-supplements marketing group and sister company to the Gourmet Mushrooms farm.

“We grow about 30 types of mushrooms, but the most popular are directly proportional to the literature behind the mushroom,” he says. “In recent years, the Japanese, Chinese and Koreans have done a lot of research on certain types of mushrooms. Maitake is so popular because there’s so much literature behind it.”

American hospitals and universities aren’t keeping the same research pace. “The few studies being performed right now are mostly more of a curiosity type,” Law says. However, Maitake Products, the Ridgefield Park, N.J.-based manufacturer of Maitake D-Fraction, was given an investigational new drug status from the U.S. Food and Drug Administration to conduct a Phase II pilot study on the treatment of advanced breast and prostate cancer. Maitake Products has “invested heavily in experimental studies and clinical trials in order to validate the efficacy of its product,” according to company literature.

As mushroom research grows, Americans will “see a lot more fungal-based product in the next few years. The demand is growing exponentially,” Law says. Until then, the medicinal mushrooms available to Americans are limited to a handful of varieties.

Maitake (*Grifola frondosa*). Maitake mushrooms grow on tree trunks in deciduous forests in temperate climates in eastern Canada, northeastern and mid-Atlantic U.S., northeastern Japan and parts of Europe. These mushrooms have fan-shaped caps and often grow in masses.

Tenney says Maitake mushrooms contain beta-D-glucan, a polysaccharide that stimulates the body's immune response. Maitake also may reduce high blood pressure. In a 1994 study conducted at the Ayurvedic Medical Center of New York, 11 volunteers given 500 mg doses of maitake twice daily reported their blood pressure was reduced by 5 percent to 20 percent.

Tenney says maitake can protect the liver and may reverse damage that has already occurred—including that from hepatitis B. It also may help treat cancer and HIV. Animal studies have found that maitake injected into the abdominal cavity reduced tumor growth by 90 percent, and it was the first mushroom found to inhibit the activity of HIV in laboratory studies.

Shiitake (*Lentinus edodes*). Shiitake mushrooms grow on dead or dying broad-leaf trees, including chestnut, beech, maple, oak, walnut and mulberry, in the temperate mountain regions of Asia. Tenney says shiitake is high in B-complex vitamins, which are necessary for cell energy and hormone production, and also contains protein, enzymes and eight essential amino acids. In addition, it includes the polysaccharide lentinan, which increases immune system activity. Lentinan is an approved drug in Japan used to treat cancer, Tenney says.

Shiitake also contains eritadenine, which lowers blood cholesterol. In a Japanese study, human volunteers ate 90 grams a day of fresh shiitake, and their cholesterol levels were reduced by an average of 12 percent. In addition, shiitake mushrooms can increase resistance to some bacterial, viral and parasitic

infections, including herpes simplex and tuberculosis, Tenney reports.

Reishi (*Ganoderma lucidum*). This bitter mushroom rarely grows in the wild, but is cultivated widely in China. There are many varieties, but akashiba, or red reishi, is most popular. Reishi, also known as the “mushroom of immortality,” is high in B vitamins, vitamins C and D, iron, calcium and phosphorus. It contains beta-D-glucan and triterpenes, which strengthen the circulatory and immune system. Tenney says reishi has the most triterpenes of any mushroom.

Tenney cites studies in which reishi lowered blood pressure and cholesterol levels. Reishi also has a component similar in structure to steroid hormones that can help reduce allergy symptoms by inhibiting the release of histamines. In addition, Tenney says, reishi is known for its adaptogenic properties, which bring the body systems into harmony.

Cordyceps (*Cordyceps sinensis*). The Chinese call this finger-size mushroom found in the highlands of China, Tibet and Nepal “winter worm, summer grass.”

This rare mushroom, once only affordable by the Chinese imperial family, is traditionally used to increase stamina, endurance and sex drive, according to the Bio Research Institute in Paramus, N.J. It also is used to relieve bronchitis, insomnia, hypertension, pneumonia, emphysema, tuberculosis, anemia, night sweats and coughs, writes Kate Gilbert Udall in *Cordyceps Sinensis : Immune and Stamina Booster* (Woodland Publishing, 2000).

Royal Agaricus (*Agaricus blazei* Murill). This mushroom grows in the mountainous region of Piedade near São Paulo, Brazil. Beth Ley, Ph.D., author of *Medicinal Mushrooms for Immune Enhancement: Agaricus blazei* Murill (BL Publications, 2001), reports that in the mid-1960s, a researcher from Pennsylvania

State University noted that occurrence of adult diseases in the Piedade region was extremely low, and attributed it to a regular diet of agaricus mushrooms.

Agaricus has the most beta-D-glucan of any mushroom, and is mostly used for treating and preventing cancer, Ley says. It also can prevent or improve chronic fatigue syndrome and autoimmune conditions such as rheumatoid arthritis, diabetes and lupus, she says. In addition, agaricus aids in digestion, reduces hair loss and, when applied topically, can heal wounds and clear up skin problems, Ley says.

Active Hexose Correlated Compound. This "superfood" nutritional supplement, developed in the late 1980s, is close to being considered a mainstream cancer therapy in Japan, writes Dan Kenner in *AHCC: The Japanese Medicinal Mushroom Immune Enhancer* (Woodland Publishing, 2001). "Part of this rapid acceptance is due to the volume of scientific research devoted to the many applications of AHCC," Kenner says, noting that AHCC research is being conducted in hospitals and universities in Japan, China, Korea, Thailand and the United States. AHCC also won the Nutracon Best New Product of 2002 award.

AHCC is a monosaccharide made from the filaments of shiitake hybrid mushrooms grown in rice bran extract. Rice bran is antiviral and supports the immune system, Kenner says. The growing process breaks down mushroom nutrients into a more absorbable form. There is clinical and laboratory evidence that this versatile mushroom extract boosts the body's immune system and treats cancer, HIV, hepatitis C and cirrhosis of the liver, chronic infections, diabetes, stress, high blood pressure and glaucoma.

Vicky Uhland is a freelance writer and editor based in Denver.



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Published by D. K. Mazumdar on behalf of "The Mushrooms"
West Kerani Para, Shurid Lane Extn., Jalpaiguri -735101, Phone : 257749
Editor - Dibyendu Kanti Mazumdar (Mushroom Scientist)

Computer Designed & Offset Printed by :

Sigma Information Technology

Somrat Complex, D.B.C. Road, Jalpaiguri

Phone : (03561) 221785