



MUSHROOMS AND HEALTH GLOBAL INITIATIVE BULLETIN

An ISMS Global Initiative to increase the worldwide consumption of mushrooms through the collection, evaluation and dissemination of scientifically validated information.

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News from the Initiative - Mary Jo Feeney

► **From the Mushrooms and Health 2010 Report – Mushrooms and umami**
Mushrooms have a different taste profile to vegetables. Their natural glutamates give mushrooms – which are not a source of monosodium glutamate (MSG) – a meaty or savory flavor, known as umami. There is a lot of interest in the umami flavour and the role of glutamates in health (*American Journal of Clinical Nutrition* 2009; 90 supplement).

A section in the *Mushrooms and Health Report 2010* describes what is currently known about mushrooms and umami. Glutamic acid, its salts, i.e., glutamates, and certain 5'-ribonucleotides are taste-active chemicals responsible for the taste umami, described as the fifth flavour of food after sweet, salty, bitter and sour. High levels of both glutamates and the ribonucleotides occur in the cultivated mushroom *Agaricus bisporus* after it is aged for a few days and in dried shiitake mushrooms.

Umami taste receptors on the taste buds come into contact with glutamate and this information is relayed to the brain via the vagus nerve and the umami taste is recognised by the brain. Furthermore, research has discovered that there are glutamate receptors not only on the tongue, but also in the stomach. Glutamate, in the form of calcium diglutamate, has been shown to improve the flavour of low sodium products suggesting that mushrooms may play an important role in enhancing the flavour of reduced sodium products.

For references and citations on mushrooms and umami, visit the Mushrooms and Health website: <http://www.mushroomsandhealth.com/mushrooms-health-report/mushroom-nutrients-amp-umami-nc-106-3-2/>.

Mushroom Research

► **Ergothioneine bioavailability in healthy adult males**

Weigand-Heller AJ, Kris-Etherton PM, and Beelman RB. [The bioavailability of ergothioneine from mushrooms \(*Agaricus bisporus*\) and the acute effects on antioxidant capacity and biomarkers of inflammation.](#) *Preventive Medicine*. In press and available online Dec. 31, 2011. doi:10.1016/j.ypmed.2011.12.028.

Ergothioneine (ET) is a sulfur containing amino acid that functions as an antioxidant. Mushrooms, a primary source of ET, contain from 0.4-2.0 mg/g (dry-weight). The bioavailability of ET from mushrooms in humans remains unclear.

The investigators evaluated the bioavailability of ET in 10 healthy men in a pilot study, using a randomized, cross-over, dose-response, postprandial time-course design. ET was administered through a mushroom test meal containing 8 g and 16 g of mushroom powder, equivalent to about 1 or 2 servings of fresh mushrooms respectively. Postprandial red blood cell concentrations of ET were measured. Plasma glucose, triglycerides, HDL, LDL and total cholesterol also were monitored. Biomarkers of inflammation and oxidative stress were evaluated using C-reactive protein and ORAC_{total}.

According to the results, ET was bioavailable and a trend in the postprandial triglyceride response indicated that there was a blunting effect after both the 8 g and 16 g ET doses compared with the 0 g dose. Despite ET's antioxidant properties, ORAC_{total} values decreased after the 8 g and 16 g mushroom meal. The investigators state that ET exerts antioxidant properties through multiple mechanisms aside from scavenging free radicals and that due to the various mechanisms of action, antioxidant capacity would be better measured by an oxidative stress biomarker.

► **Vitamin D enhanced foods – a review**

O'Mahony L, Stepien M, Gibney MJ, Nugent AP, and Brennan L. [The potential role of vitamin D enhanced foods in improving vitamin D status](#). *Nutrients* 2011, 3, 1023-1041. The article is freely available and re-usable through Open Access.

This review examines studies investigating effects of vitamin D enhanced foods, including mention of UV treated mushrooms, in humans. With a limited number of natural dietary sources of vitamin D, there is a real need for alternatives to improve dietary intake. Enhancement of foods with vitamin D is a possible mode for ensuring increased consumption and thus improved vitamin D status. Low vitamin D intake and status have been reported worldwide and many studies have suggested that this low status may be involved in the development of several chronic diseases.

Table 2 lists randomized clinical trials providing at least 10µg of vitamin D2 or D3 each day with foods that were enhanced with vitamin D and the percent change from baseline of serum levels of 25(OH)D. Although a comparison between the studies is difficult due to variability in the population characteristics (i.e., age, gender), dose of vitamin D provided, intervention period and methods used for 25(OH)D, a range of enhanced foods were shown to be effective in increasing circulating 25(OH)D concentrations with no signs of adverse effects.

► **Wild/poisonous mushroom extract may improve efficacy of cancer drugs**

Liu F, Liu Q, Yang D et al. [Verticillin A overcomes apoptosis resistance in human colon carcinoma through DNA methylation-dependent upregulation of BNIP3](#). *Cancer Res*; 71(21); 6807–16. <http://cancerres.aacrjournals.org/content/71/21/6807.abstract>.

Drug resistance is a major cause of failure in cancer chemotherapy. Identification and combined use of adjuvant compounds that can overcome drug resistance may improve the efficacy of cancer therapy. The investigators screened extracts

ET in mushrooms is bioavailable and is associated with a blunting of the after-meal triglyceride response.

Vitamin D enhanced foods are effective in raising circulating levels of 25(OH)D.

Verticillin A holds potential as a companion drug for use in cancer therapy.

of *Verticillium* species-infected mushrooms for antitumor compounds and identified the compound Verticillin A as an inducer of hepatoma cell apoptosis *in vitro* and an inhibitor of tumor xenograft growth *in vivo*.

Verticillin A exhibited a potent apoptosis-sensitizing activity in human colon carcinoma cells exposed to TRAIL (tumor necrosis factor-related apoptosis inducing ligand) or Fas *in vitro*. Verticillin A effectively sensitized metastatic human colon carcinoma xenograft to TRAIL-mediated growth inhibition *in vivo*. Verticillin A was observed to induce cell-cycle arrest in the G2 phase of the cell cycle in human colon carcinoma cells, markedly upregulating BNIP3 (a gene that promotes cell death) in both hepatoma and colon carcinoma cells. According to the investigators, Verticillin A may have potential as a potent apoptosis sensitizer as an adjuvant agent to overcome drug resistance in human cancer therapy.

► White button mushrooms and mucosal immunity

Jeong SC, Koyyalamudi SR, and Pang G. [Dietary intake of *Agaricus bisporus* white button mushroom accelerates salivary immunoglobulin A secretion in healthy volunteers.](#) *Nutrition*. 2011 Nov 22.

This study investigated the effect of dietary intake of *Agaricus bisporus* white button mushroom (WBM) on salivary IgA (sIgA) secretion in healthy subjects. Since secretory immunoglobulin A (SIgA) acts as the first line of adaptive humoral immune defense at mucosal surfaces dietary intake may improve mucosal immunity by accelerating SIgA secretion.

Twenty-four healthy adult volunteers were randomly assigned to a normal daily diet (control group) or a normal diet with WBM. The 12 subjects in the active group consumed 100 g of blanched WBM daily with their normal diet for 1 wk, whereas the 12 in the control group consumed their normal diet without WBM. Saliva was collected before and after the beginning of the study and every week thereafter for 3 wk. Saliva flow rate, sIgA concentration, and osmolality were determined and the sIgA:osmolality ratio and the sIgA secretion rate were calculated.

There was no significant difference between pre- and post-dietary mushroom intakes for all indices in the control group ($P > 0.05$). In contrast, the mean sIgA secretion rate increased significantly at weeks 1 and 2 by 53% and 56%, respectively, compared with that at week 0 ($P < 0.0005$) in the WBM intake group and then returned to a baseline level at week 3. Changes in sIgA secretion rate over the intervention period were greater in the WBM group than in the control group. In both groups, no significant changes in osmolality and saliva IgG were noted. There was, however, a significant increase in the sIgA:osmolality ratio ($P < 0.0012$), confirming the post-dietary WBM-induced sIgA increase. According to the study, dietary intake of *A. bisporus* WBM significantly accelerates sIgA secretion, thereby indicating its potential health benefits for improving mucosal immunity.

Agaricus bisporus has potential health benefits for improving mucosal immunity.

► White button mushrooms, polysaccharides and immunity

Jeong SC, Koyyalamudi SR, Jeong YT, et al. [Macrophage immunomodulating and antitumor activities of polysaccharides isolated from *Agaricus bisporus* white button mushrooms.](#) *J Med Food* 2012. Jan. 4; 15(1):58-65.

According to the investigators, mushroom polysaccharides are known for their immunomodulating and antitumor properties; however, little is known regarding

The study suggests a molecular basis to explain reported therapeutic effects of *A. bisporus* on breast cancer cell growth.

the properties of *A. bisporus* polysaccharides. Using size-exclusion chromatography to fractionate the crude extract of *A. bisporus*, two polysaccharide fractions (designated as ABP-1 and ABP-2) were obtained. The estimated molecular masses of ABP-1 and ABP-2 were 2,000 kDa and 40–70 kDa, respectively, and their sugar compositions consisted mainly of glucose, mannose, xylose, and fructose. Analysis of the effects of the polysaccharides on murine macrophages demonstrated that both fractions stimulated the production of nitric oxide, interleukin-6, and tumor necrosis factor- α . Modulation of macrophage function by *A. bisporus* polysaccharides was mediated in part through activation of nuclear factor- κ B. Both ABP-1 and ABP-2 inhibited the growth of human breast cancer MCF-7 cells but had little effect on the growth of human colon, prostate, gastric cancer, and murine Sarcoma 180 cells as assessed by a tetrazolium dye [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide]-based assay. However, when murine Sarcoma 180 cells exposed to ABP-1 or ABP-2 were implanted subcutaneously into mice, a reduction in tumor growth was observed compared with control mice. The researchers suggest that their data provide a molecular basis to explain in part the reported beneficial therapeutic effects of *A. bisporus* WBM intake and suggest that macrophages likely contribute to the antitumor effects of *Agaricus* polysaccharides.



News from Australia - Glenn Cardwell and Chris Rowley

► Vitamin D health professional seminars

In November 2011, Professor Michael Holick from Boston University, USA, visited Australia to present three vitamin D seminars to health professionals in Sydney and Melbourne, meet researchers and chat with the media. The first presentation was at Sydney University, supported by talks from breast cancer researcher Kellie Bilinski and vitamin D researcher Professor Rebecca Mason (shown in the photo with Dr. Holick). Ms Bilinski told the audience that vitamin D regulates up to 200 genes in breast cancer cell production.

The following day Dr Holick (shown in the photo with Greg Seymour) met with researchers at Deakin University in Melbourne. Joining Dr Rob Daly and Professor Caryl Nowson, who both detailed the level of vitamin D deficiency in Australia, Dr Holick spoke to another gathering of local health professionals. Finally, he presented to medical doctors at a conference in Melbourne. The feedback from delegates made it clear that the seminars were both useful and appreciated.

Dr Holick said that vitamin D is the oldest hormone on the planet. He didn't

Nearly three out of four Australians are low in vitamin D.



think there was much difference between the bioavailability of vitamin D2 and D3, and as 2000 genes are influenced by vitamin D then all sources of vitamin D could help the body stay healthy. It is widely regarded that vitamin D blood levels should be around 75 nmol/L and nearly three quarters of Australians had less than this level.

Each event was well-attended and fortuitously coincided with the first release of vitamin D mushrooms onto the Australian market, so local dietitians and doctors could savour the vitamin D mushrooms and take home a punnet for dinner. There was a pleasing interest from the media with Dr Holick getting both local and national coverage. Later, a newsletter to medical doctors gave them background information and where they could obtain vitamin D mushrooms.

► **Doctors workshops**

At the same conference that Dr Holick presented to, Glenn Cardwell gave three workshops on nutrition mythology. He finished with the story that, despite the advice still given online, mushrooms do not increase the risk, nor exacerbate the symptoms, of gout. In fact, the evidence suggests that mushrooms and vegetables reduce the risk of gout.

► **2012 plans**

We are now preparing our education program directed at health professionals throughout 2012, looking to include home economists and nutrition researchers for the first time. A series of doctors and nurses workshops has already been organised to take place in the five biggest cities in Australia. This year the International Congress of Dietetics will be in Sydney and mushrooms will host their now famous breakfast. Another big year is ahead.

Mushrooms will host a breakfast at the International Congress of Dietetics.



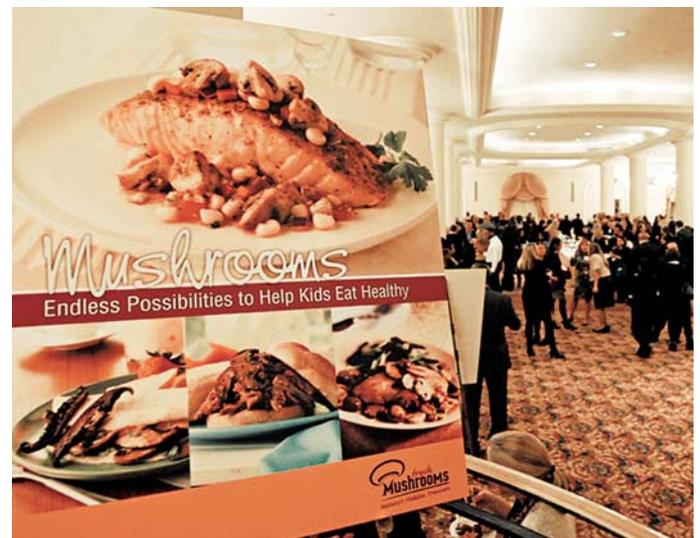
News from the United States - Heidi Gengler

► **Partnerships emphasize mushrooms in healthy eating patterns**

► **Partnership for a Healthier America**

In late November 2011, the U.S. Mushroom Council (Council) joined the Partnership for a Healthier America (PHA) as a key sponsor of the inaugural "Building a Healthier Future" Summit. PHA's event brought together 800 opinion leaders and representatives from corporations, advocacy groups, and foundations to address approaches to solving childhood obesity in the U.S. from every angle.

At the evening reception, the Council worked with menu coordinators to serve six mushroom appetizers demonstrating the mushrooms' versatility and easy ideas to get more produce onto Americans' plates. In addition to the food, the Council provided nutrition resource kits in



each attendee's registration bag. As an added bonus, well-known American chef, Tom Colicchio, used mushrooms in an evening entertainment cooking challenge, and White House Chef, Sam Kass mentioned that the Obamas have two mushroom logs in the White House vegetable garden. The photo, courtesy of the Council, shows Summit attendees socializing while tasting mushroom recipes.

► **Center for Nutrition Policy and Promotion Nutrition Communicators Network**

National partnerships align mushrooms with organizations that share the goal of promoting healthy eating, across multiple industries.

The Council recently became a National Strategic Partner in the United States Department of Agriculture (USDA) / Center for Nutrition Policy and Promotion (CNPP) Nutrition Communicators Network to further promote the 2010 Dietary Guidelines. The Council earned this distinction because of a shared goal to promote healthy eating habits, with a specific emphasis on eating more produce. Showcasing mushrooms' nutritional profile and versatility, the Council will amplify messaging surrounding MyPlate (the new USDA consumer-tool that replaced the nutritional pyramid), weight management and lowering sodium.

The Council has already taken steps to support this partnership. To date, the Council has partnered with the Produce for Better Health Foundation to develop six mushroom recipes that exemplify MyPlate recommendations (like filling half the plate with fruits and vegetables); secured Liz Ward, MS, RD, as a Council spokesperson for 2012; developed healthy recipes for use in 2012 foodservice and consumer outreach; and will continue proactive media outreach to generate widespread awareness.

Be sure to visit the Mushrooms and Health website <http://www.mushroomsandhealth.com/>

Send what's happening in your country to communicate the benefits of mushrooms to consumers, shoppers, households, doctors, health professionals and the media to info@mushroomsandhealth.com.

Note: The *Bulletin* provides links to other sites for your convenience and information. These sites contain information created, published, maintained or otherwise posted by organizations independent of the Initiative which does not endorse, approve, certify or control these sites and does not guarantee the accuracy of the information contained on them.

► **Initiative project team**

- Greg Seymour, President, ISMS General Manager AMGA, Australia; Manager, Mushrooms and Health Global Initiative
- Bart Minor, President, Mushroom Council, United States
- John Collier, Group Research and Development Manager, Monaghan Mushrooms Ltd, Republic of Ireland
- Mary Jo Feeney, Mushrooms and Health Global Initiative Operations Manager, Bulletin Editor, United States
- Glenn Cardwell, Accredited Practising Dietitian, Nutrition Impact P/L, Australia
- Chris Rowley, Communications Consultant, Australia
- Heidi Gengler, Vice President, Edelman Public Relations, United States

► **Strategic communications group**

Members of the Strategic Communications Group strengthen the Initiative's communication capability and develop a local public relations presence in each country whose industry is contributing financially to the project. Members of this group help facilitate stories about mushrooms and health appearing in their local media, monitor mushroom nutrition and health research, liaison with scientists, media and other influencers, and provide feedback to the Initiative. They include:

- Michal Slawski - United Kingdom
- Franz Schmaus - Germany
- Francois Marche - France
- Ignace Deroo - Belgium
- José Antonio Jiménez Hernandez - Spain
- Kent Stenvang - Denmark
- Dick Roodhuyzen de Vries - Netherlands
- Elizabeth O'Neil - Canada