



Mushrooms and Health Global Initiative Bulletin

Feb. 2008 Issue #1

Mary Jo Feeney, Editor info@mushroomsandhealth.com

"An ISMS Global Initiative"

We are pleased to send you the first *Mushrooms and Health Global Initiative (Initiative) Quarterly Bulletin*. You are receiving this publication because the project team (page 2) wants to share this information with as many people as possible who are involved or interested in the mushroom business around the world. Some of you would be aware of the project as a result of attending a presentation about the Initiative in London, Saumur in France or during the 4th International Medicinal Mushroom Conference, Slovenia. Others have heard about it in various ways and have expressed interest in the Initiative, while many of you will be hearing about the project for the first time as a member of a mushroom industry organization that is a member of ISMS.



Delegates at the 4th International Medicinal Mushroom Conference, Slovenia hear a presentation on the *Mushrooms & Health Global Initiative*.

An ISMS Global Initiative

The Mushrooms and Health Global Initiative is an example of a scientific and communications project that has widespread benefits for the mushroom industry worldwide. The International Society for Mushroom Science (ISMS) provides the framework for scientists and mushroom industry organizations to work collaboratively on these jointly funded projects. ISMS is keen to facilitate more of these types of projects to ensure that the limited resources available are invested in the most cost effective manner for the benefit of all those involved.

Mushrooms and Health Global Initiative Bulletin Feb. 2008 Issue #1

An ISMS Global Initiative.....	1
Mushrooms and Health Global Initiative	1
Food Science Australia/CSIRO to Conduct Comprehensive Review on the State of Mushroom and Health Research	2
Research Generates Publicity	3
Research Pipeline.....	3
• White button mushrooms and weight management	
• Effect of white button mushrooms on dendritic calls	
• White button mushrooms and prostate cancer	
Linking Research to Production - Mushrooms and Vitamin D	4
Bibliography - Mushroom Research of Interest. 6	
• Radical-scavenging properties of <i>Agaricus bisporus</i>	
• <i>Ganoderma lucidum</i> and prostate cancer	
• Mushroom intake and risk of breast cancer in Korean women	

Mushrooms and Health Global Initiative

History

The Initiative is a collaborative project to support public relations efforts that increase the worldwide consumption of mushrooms and mushroom products through the collection, evaluation and dissemination of scientifically validated information. During the 17th North American Mushroom Conference in March 2004, Australian Mushroom Growers Association (AMGA) General Manager Greg Seymour and Mushroom Council (U.S.) President Bart Minor convened a meeting to discuss worldwide cooperation in marketing mushrooms. Since then, the AMGA, the Mushroom Council and Mushrooms Canada have come together to share information, provide in-kind support for research projects and/or initial funding to support the Initiative, with GEPC (European Mushroom Growers Association), the United Kingdom and Denmark joining the effort early 2008. Other

mushroom growing/marketing organizations in Europe and Asia have been contacted to support these efforts.

Purpose and Components

To increase worldwide mushroom demand, mushrooms must move from being perceived by consumers as a supporting/ ingredient/ luxury item to an essential food used frequently. With health as a key driver to position mushrooms as the ultimate super food, eaten anyway, everyday, a research base is essential. The Mushrooms and Health Global Initiative provides the credible and scientific underpinning to support public relations efforts each country may choose to undertake. Key components of the Initiative include a thorough review and evaluation of the state of the science linking mushrooms and health; the establishment of a sustainable system to keep this scientific review document current; and, if needed, the identification of eminent scientists to lend credibility to the Initiative's efforts and provide expertise in outreach efforts.

ISMS helps connect the Initiative with interested stakeholders through communications such as this bulletin which will be distributed electronically each quarter - February, May, August and November. The bulletin updates stakeholders on the core components of the Initiative, provides a brief description of some current mushroom research or public relations efforts, and suggests Web sites or links for additional information.

How to Be Involved

Here are some ways stakeholders can enhance Initiative efforts. E-mail all inquiries to info@mushroomsandhealth.com.

- Serve as our eyes and ears for studies, press clippings or other announcements on new research that links mushrooms and health. Send us information on the research and how to contact the researcher or institution.
- Provide public relations personnel with information about the Initiative to develop stories for the media.
- Provide us with any news about mushrooms – including information about what's happening in the commercial world

- Spread the news about mushrooms and health; share the information in this bulletin every chance you get.

Initiative Project Team

Members of the Mushrooms and Health Global Initiative Team who will be contributing to this bulletin include:

- *Greg Seymour*, President, ISMS, General Manager AMGA and Manager, Mushrooms and Health Global Initiative
- *Bart Minor*, President, Mushroom Council, United States
- *William Stevens*, Executive Vice President, Mushrooms Canada
- *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
- *Margo Kraus*, Senior Account Supervisor, Edelman, United States

Food Science Australia/CSIRO to Conduct Comprehensive Review on the State of Mushroom and Health Research

In response to a worldwide call for proposals, Food Science Australia/CSIRO has been selected to conduct a systematic review of the literature to evaluate the strength of the science linking mushrooms to health. Its strategic partnerships have enabled the organization to become one of the world's leading food research organizations (See <http://www.foodscience.csiro.au>.)

Food Science Australia (FSA) is Australia's largest and most diversified food research organization and a joint venture of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the State Government of Victoria with centers in Sydney, Melbourne, Brisbane and Adelaide. CSIRO delivers research outcomes to improve human and community health with expertise in nutrition, psychology, public health, consumer and sensory science, medicine, and exercise physiology.

CSIRO's review will evaluate the strength of the science linking mushroom consumption to:

- Immune function and Inflammatory response
- Bone health
- Blood glucose, lipids and blood pressure levels
- Cancer prevention, treatment
- Brain function/dementia
- Weight management
- Dietary guidance recommendations regarding mushrooms worldwide as identified by major countries and health organizations.

In addition, CSIRO will develop a comprehensive systematic method to identify existing literature on mushrooms and health that is updatable, searchable and retrievable for use by the worldwide mushroom industry, researchers, media and health professionals on an on-going basis

According to project leader Dr. Peter Roupas, "CSIRO/Food Science Australia believes that the communication of the health benefits of foods should be based on sound scientific evidence. Accordingly, we are delighted to assist the global mushroom industry in conducting a systematic literature review to evaluate the strength of the science linking mushroom consumption to potential health benefits. An initial search of the literature indicates that over 11,000 scientific papers have been published on mushrooms and our challenge will be to examine and summarise this work systematically and critically. We commend the responsible approach that the mushroom industry is taking in its communication to consumers and look forward to undertaking the review."

Progress on the Initiative will be described May 23 during the ISMS session entitled: Nutrition Research: The Future Begins Now.

Research Generates Publicity

White button mushrooms may promote innate immunity

Results of a study by researchers at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University suggest that white button mushrooms may promote innate immunity against tumors and viruses by

enhancing natural killer (NK) cell activity through increased production of interferon-gamma. The study, "Dietary supplementation with white button mushroom enhances natural killer cell activity in C57BL/6 mice," appeared in *The Journal of Nutrition* 2007 137: 1472–1477, 2007, and was funded by the Mushroom Council. See <http://jn.nutrition.org/cgi/content/abstract/137/6/1472> for the abstract.

Woman's Day (Sept. 12, 2007) and *Men's Health* (Oct. 2007) carried articles mentioning this research generating over 21M impressions, or total exposure of Americans to the messages.

Tasteful beauty: Mushrooms among foods with potential to help you look and feel healthy

Hair and skin care preparation and innovations are taking a cue from research on how nutrients in foods can also work from the outside in – as ingredients in cosmetics. Reference to research at Pennsylvania State University (Dubost, NJ, Ou B and Beelman RB, "Quantification of polyphenols and ergothioneine in cultivated mushrooms and correlation to total antioxidant capacity" *Journal of Food Chemistry* 2007; 105 (2): 727-735) comparing antioxidant levels in certain mushrooms to other vegetables commonly perceived as antioxidant powerhouses appeared in *Cooking Light* (Oct. 30, 2007), generating about 7 M impressions, or total exposure of Americans to this message.

Research Pipeline

The following mushroom studies are anticipated to be published early 2008. Some will be published on-line prior to the print version. **Check the journal's website and search by author/s or title of article.**

White button mushrooms and weight management

"Lack of energy compensation over 4 days when white button mushrooms are substituted for beef." Cheskin LJ, Davis LM, Lipsky LM, Mitola AH, Lycan T, Mitchell V, Mickle B and Adkins E. E-mail corresponding author: Cheskin@jhmi.edu. This study is anticipated to appear in the March issue of the journal *Appetite*.

http://www.elsevier.com/wps/find/journaldescription.cws_home/622785/description#description

Substituting foods of low energy density for high energy density foods has been proposed as a way to prevent or reverse the increase in obesity. Researchers at Johns Hopkins Bloomberg School of Public Health, investigated whether substituting mushrooms for beef in a test lunch affected energy and fat intake, palatability, appetite, satiation (after meal fullness) and satiety (general fullness) in normal weight, overweight and obese adults. Total daily energy intake and fat intake were significantly greater in the meat dishes compared to the mushroom dishes while ratings of palatability, appetite, satiation and satiety did not differ significantly.

Effect of white button mushrooms on dendritic cells

“White button mushroom enhances maturation of bone marrow-derived dendritic cells and their antigen presenting function in mice.” Ren, Z, Guo Z, Meydani SN and Wu, D. E-mail: dayong.wu@tufts.edu. *The Journal of Nutrition*, 2008; 138:544-550. <http://jn.nutrition.org/>.

Dendritic cells play a vital role in linking innate (inborn/natural) immunity and adaptive (acquired) immunity. Researchers at the Nutritional Immunology Laboratory, United States Department of Agriculture (USDA) Center on Aging at Tufts University, Boston, discovered that the *in vitro* supplementation of white button mushroom (WBM) promoted maturation of dendritic cells (DC), and these mushroom-treated DC are more effective in activating specific T cell responses through improvement in their antigen-presenting function.

White button mushrooms and prostate cancer

“*Agaricus bisporus* exhibits antiproliferative and proapoptotic properties and inhibits prostate tumor growth in athymic mice), Adams LS, Phung S, Wu X, Ki L and Chen, S. *Nutrition and Cancer: an International Journal*. www.leaonline.com/loi/nc.

Linking Research to Production - Mushrooms and Vitamin D

Sun shines on mushrooms

By Glenn Cardwell

Vitamin D has become a vitamin of prime interest over the last 12 months. If there were an award for Vitamin of the Year, then vitamin D would have easily out-shone the rest in 2007. *Time* magazine included vitamin D as one of its top 10 medical breakthroughs of 2007

(http://www.time.com/time/specials/2007/top10/article/0,30583,1686204_1686252_1690393,00.html).

So, why the interest in vitamin D? It certainly enhances the absorption of calcium from the gut, making it critical for healthy bones and teeth. More recently it has been realised that vitamin D receptors appear on most organs of the body and circulating vitamin D could be protecting against a range of medical conditions.

A recent review (Autier 2007) suggested that taking vitamin D supplements reduced total mortality rates. Another trial (Lappe 2007), supplementing both vitamin D and calcium, caused a reduction in cancer incidence in post-menopausal women. Very recently, low vitamin D status has been linked to an increased risk of heart disease

(<http://www.americanheart.org/presenter.jhtml?identifier=3052800> & Wang 2008). Adequate vitamin D or vitamin D supplementation also seems to lower the risk of multiple sclerosis, gum disease, tooth loss, bowel cancer, breast cancer, prostate cancer, rheumatoid arthritis, osteoarthritis and diabetes.

This has led one editorial to state “Based on the total body of evidence of health conditions associated with vitamin D deficiency ... a more proactive attitude to identify, prevent, and treat vitamin D deficiency should be part of standard medical care” (Giovannucci 2007).

Vitamin D2 and D3

The body can make adequate vitamin D providing it is exposed to enough sunlight. It does not have to rely on dietary sources until sunlight exposure is low, such as in winter, or in people who purposely reveal little skin to the sun or have dark coloured skin. The common dietary form of vitamin D is cholecalciferol available from oily fish and table margarine,

and is commonly referred to as vitamin D3. When this is further converted to 1,25 dihydroxycholecalciferol via the liver and kidneys it becomes a potent steroid hormone. One of its roles is to enhance the absorption of calcium from the intestine.

Mushrooms are the only non-animal food that can provide vitamin D. Mushrooms have relatively high levels of ergosterol, which, under the action of UV light gets converted to ergocalciferol (known as vitamin D2). Vitamin D2 is inactive, but on consumption is converted to 25-hydroxycholecalciferol in the liver, then to 1,25-dihydroxycholecalciferol (vitamin D3) by the kidneys.

Equivalency of D2 and D3

There has been much debate as to whether dietary D2 has the same efficacy as D3. Some scientists suggest that three times as much D2 is required as D3. Armas (2004) suggests that D2 potency was less than a third of D3, while Houghton and Vieth (2006) reviewed the data to show that D2 and D3 are not equivalent and that in humans D3 is around 2-3 times more potent than D2. However, a recent article disputes the 3:1 ratio and claims that D2 is just as effective as D3 in maintaining blood levels of vitamin D when given as a supplement (Holick 2007). I suspect that D2 and D3 equivalency will be discussed for some time.

The adult requirement for vitamin D3 is around 5mcg a day (1 mcg of vitamin D = 40 International Units) in most countries that have recommended dietary intakes. These needs are thought to double in people over 50 years old. With more recent research hinting that adults in western countries are not getting enough vitamin D, future reviews may see the recommended intake of vitamin D increase.

Action of UV light on vitamin D2 levels

Scientific papers (eg Mattila 1994, 2000, 2001) reveal that mushrooms are the only non-animal based food that has vitamin D. Rarely is the *Agaricus* mushroom mentioned as a source of vitamin D. Nutrition texts generally state that mushrooms do contain ergosterol, and some mention that they have ergocalciferol (D2) by the action of UV light. The amounts found in mushrooms will vary, often depending upon how much UV radiation (or sunlight) they have received.

Various aspects of the mushroom industry have been involved in research about the feasibility - and production implications – to bring D2 enhanced mushrooms to consumers. An initial pilot study in the U.S. involving the Pennsylvania State University and Monterey Mushrooms (California) exposed mushrooms to UV light for subsequent D2 analysis by Pirjo Mattila, MTT Finland, who has published considerable research on mushrooms (See references). Based on data that were promising, and subsequent analysis by two independent laboratories confirming D2 content about three times the daily need in a serving (84 g), additional work on commercialising the UV exposure process continues.

Mushrooms Canada and Guelph Food Technology Centre are working to establish the parameters (light source, distance and time) necessary to produce D enhanced mushrooms and a set of recommendations for growers/packers wishing to adopt the technology. Building on its experience in the pilot study, Monterey Mushrooms anticipates introducing D2 enhanced mushrooms by mid-2008.

Professor David Beyer, Pennsylvania State University, who conducted trials subjecting *Agaricus* mushrooms to UV light to observe the increase in D2 levels, spoke at the Australian Mushroom Growers Association conference in October 2007. Dr Beyer stated that in his trials vitamin D2 was raised to 200% of the RDA after 60 minutes of UVB treatment before the mushrooms were harvested. The D2 levels then slowly dropped off in the five days after harvest.

Mushroom farmer, Graham Price, and the University of Western Sydney have run a series of trials in Dubbo, New South Wales, Australia. *Agaricus* mushrooms received UVB light both during the growing phase and post harvest to determine the most efficient way of elevating D2 in a commercial environment.

It is early days, but there is hope that vitamin D2 can be raised to a level that will provide health benefits to the consumer. There are many questions to be answered regarding UV treatment (eg dose, timing, retention of D2, shelf life) before we can offer the public vitamin D2 enhanced mushrooms, but we have already taken the first significant steps.

References:

Armas LAG, Hollis BW, Heaney RP. Vitamin D2 is much less effective than vitamin D3 in humans. *J of Clinical Endocrinology & Metabolism* 2004; 89 (11): 5387-5391.

Autier P, Gandini S. Vitamin D supplementation and total mortality. *Archives Internal Medicine* 2007; 167 (16): 1730-1737.

Giovannucci E. Can vitamin D reduce total mortality? *Arch Intern Med* 2007; 167 (16): 1709-1710.

Holick MF, Biancuzzo RM, Chen TC, Klein EK, Young A, Bibuld D, Reitz R, Salameh W, Ameri A, Tannenbaum AD. Vitamin D2 is as effective as vitamin D3 in maintaining circulating concentrations of 25-hydroxyvitamin D. *J Clin Endocrin Metabolism* 2007 (doi:10.1210/jc.2007-2308).

Houghton LA, Vieth R. The case against ergocalciferol (vitamin D2) as a vitamin supplement. *Am J Clin Nutr* 2006; 84: 694-697.

Jasinghe VJ, Perera CO, Barlow PJ. Bioavailability of vitamin D2 from irradiated mushrooms: an in vivo study. *British Journal of Nutrition* 2005; 93: 951-955.

Jasinghe VJ, Perera CO, Barlow PJ. Vitamin D2 from irradiated mushrooms significantly increases femur bone mineral density in rats. *Journal of Toxicology & Environmental Health (Part A)* 2006; 69: 1979-1985.

Lappe JM, Travers-Gustafson D, Davies KM, Recker RR, Heaney RP. Vitamin D and calcium supplementation reduces cancer risk: results of a randomised trial. *Am J Clin Nutr* 2007; 85: 1586-1591.

Mattila P, Piironen VI, Uusi-Rauva EJ, Koivistoinen PE. Vitamin D contents in edible mushrooms. *J Agric Food Chemistry* 1994; 42: 2449-2453

Mattila P, Ronkainen R, Lehikoinen K, Piironen V. Effect of household cooking on the Vitamin D content in fish, eggs, and wild mushrooms. *J of Food Composition and Analysis* 1999; 12: 153-160.

Mattila P, Suonpää, K, Piironen V. Functional properties of edible mushrooms. *Nutrition* 2000; 16: 694-696.

Mattila P, Konko K, Euroala M, Pihlava J-M, Astola J, Vahteristo L, Hietaniemi V, Kumpulainen J, Valtonen M, Piironen V.

Contents of vitamins, mineral elements, and some phenolic compounds in cultivated mushrooms. *J Agric Food Chem* 2001; 49: 2343-2348.

Mau JL, Chen PR, Yang JH. Ultraviolet irradiation increased vitamin D2 content in edible mushrooms. *J Agric Food Chem* 1998; 46: 5269-5272.

Outila TA, Mattila PH, Piironen VI, Lamberg-Allardt. Bioavailability of vitamin D from wild mushrooms (*Cantharellus tubaeformis*) as measured with a human bioassay. *Am J Clin Nutr* 1999; 69: 95-98.

Wang TJ, Pencina MJ, Booth SL, Jacques PF, Ingelsson E, Lanier K, Benjamin EJ, D'Agostino RB, Wolf M, Vasan RS. Vitamin D deficiency and risk of cardiovascular disease. *Circulation* 2008; 117 (DOI: 10.116/CIRCULATIONAHA.107.706127).

Bibliography - Mushroom Research of Interest.

Radical-scavenging properties of Agaricus bisporus

"Radical-scavenging properties of extracts from the white button mushroom, *Agaricus bisporus*." Savoie JM, Minvielle N and Largeteau ML. *Journal of the Science of Food and Agriculture* 2008. Published on line Feb. 5. <http://www3.interscience.wiley.com/cgi-bin/abstract/117905776/ABSTRACT>.

Ganoderma lucidum and prostate cancer

"Androgen receptor-dependent and independent mechanisms mediate *Ganoderma lucidum* activities in LNCaP Prostate cancer cells," Zaidman BZ, Wasser SP, Nevo E and Mahajna JA. *International Journal of Oncology*, 2007; 31(4): 959-967.

"Mushroom substances as therapeutics for hormone-refractory prostate cancer." Mahajna, JA, Zaidman BZ et al, *International Journal of Medicinal Mushrooms*, 2007; Vol. 9, Nos. 3&4, pp. 212-13

"Adverse effects of *Hypholoma fascicular* and *Bjerkandera adusta* mycelium and culture broth extracts on prostate and breast cancer cell lines." Zaidman BZ, Lutin A, Wasser SP, Nevo E, Mahajna J. *Int J Med Mushr* 2007.9(1): 39-46.

“*Coprinus comatus* and *Ganoderma lucidum* extracts interfere with androgen receptor function in LNCaP prostate cancer cells.”
Zaidman BZ, Wasser SP, Nevo E, Mahajna J.
Mol Biol Rep 2007. Mar 13.

Mushroom intake and risk of breast cancer in Korean women

“A case-control study on the dietary intake of mushrooms and breast cancer risk among Korean women.” Hong SA, Kim K, Nam SF, Kong G, Kim MK. *International Journal of Cancer* 2007; Vol 122, Issue 4, pp. 919-923.

###